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OF

ECONOMIC ENTOMOLOGY

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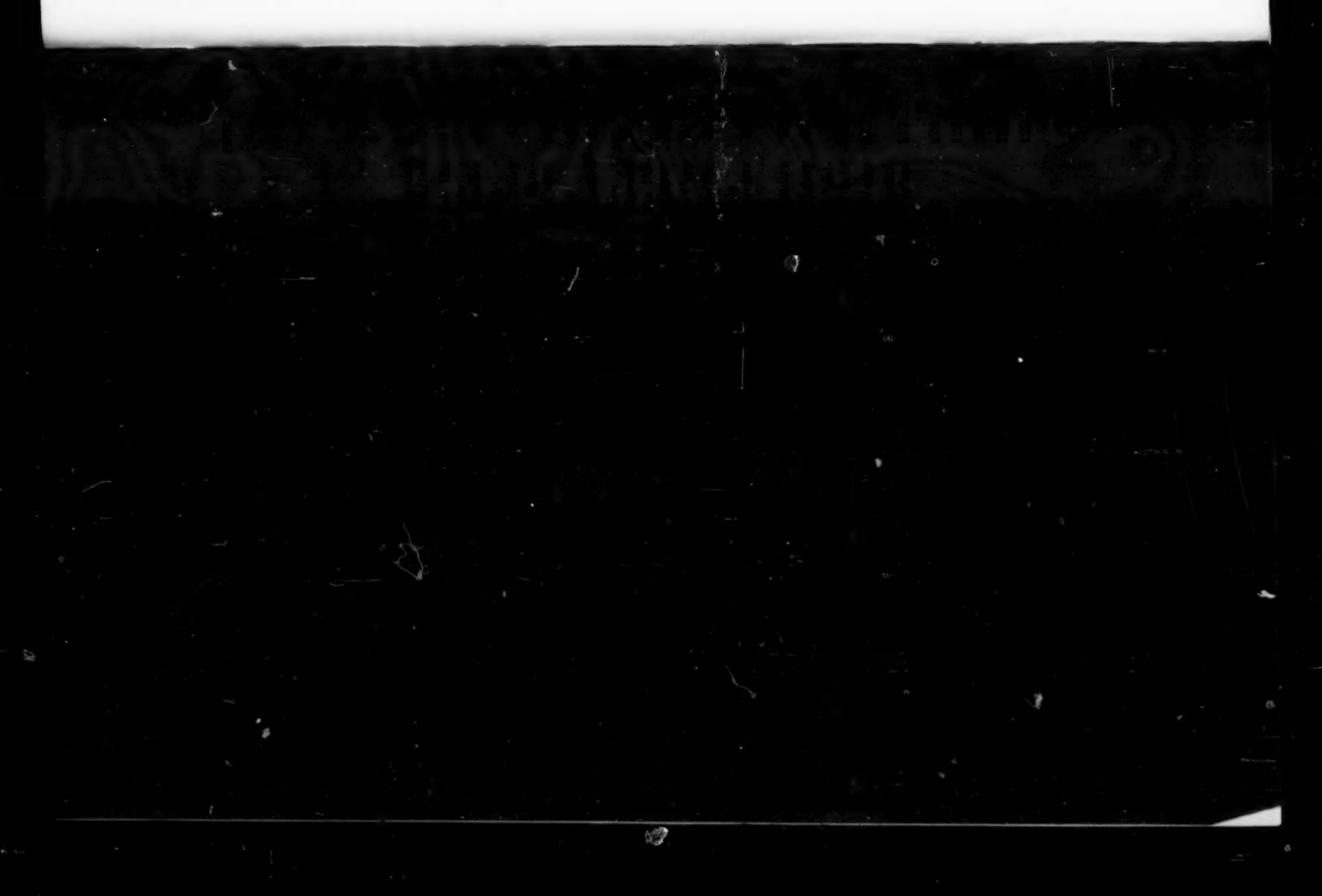

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[1] Withdrawn for publication elsewhere.

THIRTY-SECOND ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

St. Louis, Mo., December 31, 1919 and January 1–2, 1920

The thirty-second annual meeting of the American Association of Economic Entomologists will be held in the Soldan High School on December 31, 1919 and January 1 and 2, 1920.

Sessions will open at 10 a. m., Wednesday, December 31. The annual reports of the officers and standing committees, also the report of the new committee on policy, will be presented at this time, followed by the annual address of the president. The meeting of the general association will be continued at 1.30 p. m., and on Thursday at 10 a. m. The sessions on Friday will be held at 10 a. m. and 1.30 p. m. and the final business meeting will take place late Friday afternoon, unless the length of the program makes an evening session necessary.

Thursday evening has been held open so that an informal dinner or smoker can be arranged if the members so desire.

Sectional Meetings

The meeting of the Section on Apiculture will be held at 8 p. m. Wednesday, December 31. The Section on Horticultural Inspection will meet Thursday at 1.30 p. m.

Other Meetings

The annual meeting of the American Association for the Advancement of Science will be held throughout the week, also meetings of many of the affiliated societies. The Entomological Society of America will meet on Monday and Tuesday, December 29 and 30.

Hotel Headquarters

Hotel headquarters for this association will be at the Warwick, 15th and Locust Sts., where the following rates have been secured; single room $2.00 to $3.50 per day, double room $3.00 to $5.00 per day. A considerable saving can be made by members who are willing to occupy rooms jointly. All rooms are equipped with bath or shower, hot and cold water and circulating ice water. Members are requested to order their rooms at the earliest possible date.

Railroad Rates

Information concerning railroad rates to the meeting should be secured direct from Dr. L. O. Howard, Permanent Secretary, Smithsonian Institution, Washington, D. C.

Official Buttons

Official buttons for members of this association will be furnished to all members who have paid their dues for 1920. Applications for buttons should be made to the secretary at the time of the meeting.

Membership

Application blanks for membership can be secured from the secretary or from members of the committee on membership, and all applications should be made out, properly endorsed, and filed with the membership committee on or before December 31.

Program

Wednesday, December 31, 1919, 10.00 a. m.

Report of the Secretary.
Report of the executive committee,* by President W. C. O'Kane.
Report of the committee on policy, by E. D. Ball, Ames, Iowa.
Report of the employment bureau, by W. E. Hinds, Auburn, Ala.
Report of the committee on nomenclature, by Glenn W. Herrick, Ithaca, N. Y.
Report of the committee on entomological investigations, by George A. Dean, Manhattan, Kan.
Report of the committee on index of economic entomology, by E. P. Felt, Albany, N. Y.
Report of the committee on U. S. National Museum, by J. J. Davis, Riverton, N. J.
Report of the committee on amendments to the Constitution and By-Laws, by P. J. Parrott, Geneva, N. Y.

The committee will report on proposals to amend Article III of the Constitution and Article II of the By-Laws.

Article III of the Constitution reads as follows:

"SECTION 1. The officers shall consist of a President, one Vice-president, and an additional Vice-president for each branch or section, who shall be elected annually, and a Secretary who shall be elected for a term of three years, who shall perform the duties customarily incumbent upon their respective offices and as defined in the by-laws. The above officers shall act as the Board of Directors and shall pass on any urgent matters that cannot be deferred until the annual meeting. The President shall not hold office for two consecutive terms."

*This report will discuss the question of salaries of Entomologists.

The proposal at the Baltimore meeting was to amend as follows:

"SECTION 1. Amend by striking out the second sentence which reads: 'The above officers shall act as the Board of Directors and shall pass on any urgent matters that cannot be deferred until the annual meeting.'"

Add the following section:

"SECTION 2. There shall be a Board of Directors to be composed each year of the President, Secretary, and Editor of the JOURNAL, as *ex-officio*, and five members elected for five years each, one retiring each year. The Chairman shall be elected by the board."

Article II, Section 4, of the By-Laws reads as follows:

"SECTION 4. The publication of the JOURNAL OF ECONOMIC ENTOMOLOGY shall be entrusted to an Editor, an Associate Editor and a Business Manager, nominated by an advisory committee of six members, which latter shall be elected for terms of three years so arranged that two shall be elected annually. The members of this committee shall have an advisory relation to the above constituted Editorial Board."

The proposal at the Baltimore meeting was to amend as follows:

"SECTION 4. The publication of the JOURNAL OF ECONOMIC ENTOMOLOGY shall be entrusted to an Editor, an Associate Editor and a Business Manager, nominated by the Board of Directors. The members of this committee shall have an advisory relation to the above constituted Editorial Board."

"SECTION 5. The Board of Directors shall have as its function the originating and directing of all policies of the association and its various undertakings; the formulation and fostering of great entomological policies for the profession, and the working out of a more perfect coördination of scientific efforts among entomologists and between entomologists and other professions."

Appointment of committees.

Miscellaneous business.

New business.

Annual Address of the President, W. C. O'Kane, Durham, N. H. "The Day's Work."

READING OF PAPERS

"Effect of Storm Phenomena on Insect Activity," by D. C. Parman, Uvalde, Tex. (15 minutes.)

Notes made on activity of insects during storm; barometric pressure, high wind and rainfall.

"The Control of Breeding of Yellow-Fever Mosquitoes in Ant Guards, Flower Vases, etc.," by James Zetek, Ancon, C. Z. (15 minutes.)

"Mosquito Control in a Southern Army Camp," by S. M. Dohanian, Melrose Highlands, Mass. (8 minutes.)

Method and procedure of mosquito control work, with a view to permanent eradication of malarial mosquitoes, at Kelley Field, Tex.

"New Facts Concerning the Habits of the Rocky Mountain Spotted-Fever Tick, *Dermacentor venustus* Banks," by R. R. Parker, Bozeman, Mont. (15 minutes.)

"The Ecology of Certain Insects Which Infest Stored Food Products," by Royal N. Chapman, St. Paul, Minn. (10 minutes.) Lantern.

Factors which influence the abundance of insects in various products and their importance in the control of the insects.

Adjournment.

Program

Wednesday, December 31, 1919, 1.30 p. m.

Discussion of the Presidential Address.

READING OF PAPERS

"Possibility of Exterminating Certain External Parasites of Live Stock and Poultry," by F. C. Bishopp, Dallas, Tex. (15 minutes.)

"The Extermination of the Pink Bollworm of Cotton in Texas," by Ernest E. Scholl, Austin, Tex. (15 minutes.)

"The Extermination of the Pink Bollworm of Cotton in Texas," by W. D. Hunter, Washington, D. C. (15 minutes.)

"The European Corn Borer Problem," by E. P. Felt, Albany, N. Y. (15 minutes.)

General discussion of local and national aspects.

"The Work of the Railroad Entomologist," by V. I. Safro, Louisville, Ky. (15 minutes.)

"Professional Entomology: The Call and the Answer," by E. H. Gibson, Alexandria, Va. (10 minutes.)

"Commercial and Professional Entomology—The Future of Our Profession," by W. Dwight Pierce, Denver, Colo. (15 minutes.)

Will show wherein modern business life holds out better prospects to the entomologist than the official state, federal, and institutional positions.

A general survey of the possible developments of this new field and some of the qualifications necessary.

"Notes on Poisoning the Boll Weevil," by Wilmon Newell, Gainesville, Fla. (15 minutes.)

Carefully made experiments show that the efficacy of lead and calcium arsenates is not increased by the presence of dew or rain water on the plants.

"Stabilizers for Oil Emulsions," by W. W. Yothers, Orlando, Fla. (5 minutes.)

"Soil Insecticide Tests," by J. J. Davis, Riverton, N. J. (10 minutes.)

Brief summary of miscellaneous soil insecticide tests against *Cyclocephala Anomola?*, *Popillia*, and *Cotinus* grubs.

"Outline of Project Work in Extension Entomology," by E. G. Kelly, Manhattan, Kan. (15 minutes.) Lantern.

"Some Results of the Special Spray Service Conducted in New York State," by C. R. Crosby and R. G. Palmer, Ithaca, N. Y. (10 minutes.)

This paper deals with the organization of an efficient spray service in certain fruit-producing counties of New York state conducted in coöperation with the farm bureaus.

"Two 'Spray Your Orchard Week' Campaigns in Mississippi," by R. W. Harned and O. I. Snapp, Agricultural College, Miss. (8 minutes.)

Organization and results of two spraying campaigns in Mississippi.

Adjournment.

SECTION ON APICULTURE

W. E. BRITTON, *Chairman.* G. M. BENTLEY, *Secretary.*

Program

Wednesday, December 31, 8.00 p. m.

Address by the Chairman, W. E. Britton, New Haven, Conn.

READING OF PAPERS AND DISCUSSIONS

"The Economic Importance of Beekeeping in Entomological Work," by E. R. Root, Medina, Ohio.

"What Some Entomologists Are Doing for Beekeeping," by Kenneth Hawkins, Watertown, Wis.

"Honey Production," by G. A. Koger, Meridian, Idaho.

"Boys and Girls Bee Clubs," by Frank C. Pellett, Hamilton, Ill.

"Adaptation of System to Locality," by Frank C. Pellett, Hamilton, Ill.

Seasons and flora vary so greatly that much skill is necessary to make the most of the possible crop.

"The Relation of Bees to Fire Blight," by H. A. Gossard, Wooster, Ohio.

"Some Old New Phases of Bee Disease," by E. F. Phillips, Washington, D. C.

"Preliminary Notes on the Value of Winter Protection of Bees," by J. H. Merrill, Manhattan, Kan.

Number of hives with a known quantity of honey and a known quantity of bees placed on scales, and daily readings taken for two years indicate that windbreak, plenty of stores, and packing are very essential.

"Beekeeping in the California National Forests," by George A. Coleman, Berkeley, Calif. (3-reel motion picture.)

"Sweet Clover as a Bee Pasturage," by George G. Ainslie, Knoxville, Tenn.

"Arsenical Poisoning of Bees," by W. A. Price, Lafayette, Ind.

An invitation has been received to visit the C. P. Dadant factory and bee yards at Hamilton, Ill., January 3. Details will be announced at this session.

Transaction of business and selection of officers.

Adjournment.

Program

Thursday, January 1, 1920, 10.00 a. m.

READING OF PAPERS

"Western Twig Pruners," by F. B. Herbert, Los Gatos, Calif. (8 minutes.)

Species concerned, manner of severing twigs, food plants, etc., of several western twig pruners; all beetles.

"The Pacific Oak Twig-Girdler (*Agrilus angelicus* Horn.)," by H. E. Burke, Los Gatos, Calif. (10 minutes.)

Biological notes on a serious enemy of western oak shade trees.

"Distribution of Shade Tree Insects in 1919," by W. O. Hollister, Kent, Ohio. (10 minutes.)

This paper takes up the distribution and abundance of shade tree insects east of the Mississippi River during this season.

"Ten Years of the Oriental Moth," by H. T. Fernald, Amherst, Mass. (5 minutes.)

"The Control of Codling Moth with Spray-Gun, Rod and Dusting Method—Three-Year Tests," by Leroy Childs, Hood River, Ore. (10 minutes.)

"Features of the Codling Moth Problem in the Ozarks," by Dwight Isely and A. J. Ackerman, Bentonville, Ark. (10 minutes.)

Certain phases of the seasonal history of the codling moth vary widely from those of the more northern fruit sections.

"Some Experiences with the Codling Moth." by T. J. Headlee, New Brunswick, N. J. (15 minutes.)

"Field Experiments for the Control of the Apple Maggot," by Glenn W. Herrick, Ithaca, N. Y. (6 minutes.)

A brief outline of previous infestation of these orchards, the spraying mixture used and the results.

"Wild Hawthorns as Hosts of Apple, Pear and Quince Pests," by W. H. Wellhouse, Ithaca, N. Y. (5 minutes.)

An enumeration of the principal pests of these fruits which feed also on hawthorns, and some notes regarding the abundance of these pests on the hawthorns about Ithaca.

"The Oyster-Shell Scale in Illinois," by P. A. Glenn, Urbana, Ill. (10 minutes.) Lantern.

The most prevalent oyster-shell scale in Illinois is not identical with *L. ulmi* and is much more destructive to a number of ornamental trees and shrubs than *L. ulmi*.

"The Plum Web-Spinning Saw-Fly (*Neurotoma inconspicua* Norton McGillivray), Its Life History and Control," by H. C. Severin, Brookings, S. D. (10 minutes.)

The life history of the insect, also the natural and artificial control measures.

"A Preliminary Report on the Use of the Sodium Cyanide and Other Measures for Controlling the Peach Tree Borer," by Alvah Peterson, New Brunswick, N. J. (15 minutes.) Lantern.

The effect of sodium cyanide on peach trees and the larvæ within. New types of protectors and the response of the larvæ to the same. Other notes.

"Some Studies on the Effects of Arsenical and Other Insecticides on the Larvæ of the Oriental Peach Moth," by Alvah Peterson, New Brunswick, N. J. (Read by title.)

"Dust *v.* Spray for Control of Sour Cherry Pests in Pennsylvania," by J. G. Sanders and D. M. DeLong, Harrisburg, Pa. (10 minutes.)

"Results of Spraying and Dusting Experiments in Mississippi for the Control of Peach Pests, Summer 1919," by O. I. Snapp, Agricultural College, Miss. (10 minutes.)

Adjournment.

SECTION ON HORTICULTURAL INSPECTION

E. C. COTTON, *Chairman.* J. G. SANDERS, *Secretary.*

Program

Thursday, January 1, 1920, 1.30 p. m.

Address by the Chairman, E. C. Cotton, Columbus, Ohio.

READING OF PAPERS AND DISCUSSIONS

"Treating Nursery Stock for the Control of San José Scale," by K. C. Sullivan, Columbia, Mo.

"The Present Status of *Aleurocanthus woglumi* Ashby in the Panama Canal Zone," by H. F. Dietz, Washington, D. C.

"Important Foreign Insect Pests Collected on Imported Nursery Stock in 1919," by E. R. Sasscer, Washington, D. C.

"The Japanese Beetle Problem," by J. J. Davis, Riverton, N. J.

"The Japanese Beetle Quarantine Work," by C. H. Hadley, Riverton, N. J.

"Federal Plant Quarantine Work and Coöperation with State Officials," by C. L. Marlatt, Washington, D. C.

Ample opportunity for discussion will be given. In consequence of the enactment of the Federal Plant Quarantine effective July 1, 1919, every state inspection official will welcome Mr. Marlatt's discussion of this subject.

Transaction of business and selection of officers.

Adjournment.

Program

Friday, January 2, 10.00 a. m.

READING OF PAPERS

"Dipping Tobacco Plants at Setting Time for the Control of the Tobacco Flea Beetle," by Z. P. Metcalf, West Raleigh, N. C. (10 minutes.) Lantern.

A summary of the results secured by dipping tobacco plants in arsenical solution at setting time.

"The Work of *Empoasca mali* on Potato Foliage," by P. J. Parrott and R. D. Olmstead, Geneva, N. Y. (10 minutes.)

An account of the results of a number of experiments to determine the character of injuries to potato leaves by the leafhopper.

"Control of the Potato Leafhopper (*Empoasca mali* LeB.) and Prevention of 'Hopperburn,'" by J. E. Dudley, Jr., Madison, Wis. (10 minutes.) Lantern.

Field control of the potato leafhopper by spraying with consequent effect upon "hopperburn."

"The Life History of the Potato Leafhopper," by F. A. Fenton and Albert Hartzell, Ames, Iowa. (15 minutes.)

Life history studies under Iowa conditions.

"What Percent of Tipburn of Potato Is Caused by the Leafhopper," by E. D. Ball and F. A. Fenton, Ames, Iowa. (10 minutes.)

Report of the season's work on the artificial production and prevention of tipburn.

"Injuries to Beans in the Pod by Hemipterous Insects," by Ira M. Hawley, Ithaca, N. Y. (5 minutes). Lantern.

Feeding punctures of sucking insects and the dimple-like deformities which result.

"Data on Life History and Control of the Common Squash Bug," by F. M. Wadley, Manhattan, Kan. (10 minutes.)

"The Strawberry Rootworm Injuring Roses in Greenhouses," by C. A. Weigel and E. L. Chambers, Washington, D. C. (15 minutes.) Lantern.

Adjournment.

Program

Friday, January 2, 1.30 p. m.

READING OF PAPERS

"Poisoned Baits for Grasshoppers," by W. P. Flint, Urbana, Ill. (10 minutes.)

Results of recent work in Illinois with poisoned baits.

"Organization for Grasshopper Control," by G. A. Dean and E. G. Kelly, Manhattan, Kan. (12 minutes.) Lantern.

The Kansas grasshopper law; organizing of 36 counties; distribution of 7,000 tons of bran mash and the results.

"A Connecticut Corn Field Injured by *Crambus præfectellus* Zinck," by W. E. Britton, New Haven, Conn. (7 minutes.)

A description of injury, the first of its kind ever noticed in Connecticut corn on sod land.

"A Study of the Oviposition of the Corn Earworm with Relation to Certain Phases of the Life Economy and Measures of Control," by J. W. McColloch, Manhattan, Kan. (15 minutes.)

A detailed study of oviposition in the field.

"Broom Corn, the Probable Host in Which *Pyrausta nubilalis* Hubn. Reached America," by H. E. Smith, Arlington, Mass. (10 minutes.)

"The Larger Corn-Stalk Borer *Diatræa zeacolella* Dyar," by R. W. Leiby, Raleigh, N. C. (12 minutes.) Lantern.

Brief life history and suppressive measures.

"The Corn-Stalk Weevil," by G. G. Ainslie, Knoxville, Tenn. (5 minutes.)

Brief notes on the life history and habits of *Centrinus penicellus*, the larvæ of which are very commonly found boring in corn stalks in the southeastern states.

"Notes on the Habits of *Calandra pertinex* Oliv.," by A. F. Satterthwait, Webster Groves, Mo. (15 minutes.)

Host plants, distribution, economic status and life history.

"The Green Clover Worm (*Plathypena scabra*) on Soy Beans," by Franklin Sherman, Raleigh, N. C. (15 minutes.) Lantern.

Account of investigations at two field stations in North Carolina. Life history, parasites, control, etc.

"Life Histories of Some Kansas *Lachnosterna*," by W. P. Hayes, Manhattan, Kan. (15 minutes.)

The result of studies on the life-cycle of seven species of *Lachnosterna* found in Kansas.

"The Chinch Bug in Montana," by J. R. Parker, Bozeman, Mont. (10 minutes.)

First reported occurrence of the chinch bug in Montana with evidence to show that it hibernates as a nymph instead of an adult as in other states.

"The Hessian Fly and Factors Influencing Its Relation to the Wheat Plant," by L. Haseman, Columbia, Mo. (10 minutes.) Lantern.

A discussion of the work of the fly on wheat and those factors which seem to influence the susceptibility of the plant to its attack.

"The Rate of Multiplication in the Hessian Fly," by W. R. McConnell, Carlisle, Pa. (15 minutes.)

The normal rate of reproduction based on egg-counts, with a discussion of the various factors involved in working out a fair average.

Final Business

Report of committee on auditing.

Report of committee on resolutions.

Report of committee on membership.

Report of other committees.

Nomination of Journal officers by advisory committee.

Report of committee on nominations.

Election of officers.

Miscellaneous business.

Fixing the time and place of next meeting.

Final adjournment.

W. C. O'Kane, *President*,
Durham, N. H.

A. F. Burgess, *Secretary*,
Melrose Highlands, Mass.

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

(Organized 1889, Incorporated December 29, 1913)

OFFICERS, 1919

President

W. C. O'KANE, Durham, New Hampshire

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T. J. Headlee, New Brunswick, New Jersey. Term expires 1920.
E. R. Sasscer, Washington, District of Columbia. Term expires 1921.

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V. L. Kellogg, Stanford University, California. Term expires 1922.
E. P. Felt, Albany, New York. Term expires 1921.
Herbert Osborn, Columbus, Ohio. Term expires 1920.
E. D. Ball, Ames, Iowa. Term expires 1919.

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C. P. Gillette, Fort Collins, Colorado.

Entomologists' Employment Bureau.

W. E. Hinds, Director, Auburn, Alabama.

LIST OF MEETINGS AND PAST OFFICERS

First Annual Meeting, Washington, D. C., Nov. 12–14, 1889. President, C. V. Riley; First Vice-President, S. A. Forbes; Second Vice-President, A. J. Cook; Secretary, John B. Smith.

Second Annual Meeting, Champaign, Ill., Nov. 11–13, 1890. (The same officers had charge of this meeting.)

Third Annual Meeting, Washington, D. C., Aug. 17–18, 1891. President, James Fletcher; First Vice-President, F. H. Snow; Second Vice-President, Herbert Osborn; Secretary, L. O. Howard.

Fourth Annual Meeting, Rochester, N. Y., Aug. 15–16, 1892. President, J. A. Lintner; First Vice-President, S. A. Forbes; Second Vice-President, J. H. Comstock; Secretary, F. M. Webster.

Fifth Annual Meeting, Madison, Wis., Aug. 14–16, 1893. President, S. A. Forbes; First Vice-President, C. J. S. Bethune; Second Vice-President, John B. Smith; Secretary, H. Garman.

Sixth Annual Meeting, Brooklyn, N. Y., Aug. 14–15, 1894. President, L. O. Howard; First Vice-President, John B. Smith; Second Vice-President, F. L. Harvey; Secretary, C. P. Gillette.

Seventh Annual Meeting, Springfield, Mass., Aug. 27–28, 1895. President, John B. Smith; First Vice-President, C. H. Fernald; Secretary, C. L. Marlatt.

Eighth Annual Meeting, Buffalo, N. Y., Aug. 21–22, 1896. President, C. H. Fernald; First Vice-President, F. M. Webster; Second Vice-President, Herbert Osborn; Secretary, C. L. Marlatt.

Ninth Annual Meeting, Detroit, Mich., Aug. 12–13, 1897. President, F. M. Webster; First Vice-President Herbert Osborn; Second Vice-President, Lawrence Bruner; Secretary, C. L. Marlatt.

Tenth Annual Meeting, Boston, Mass., Aug. 19–20, 1898. President, Herbert Osborn; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, C. L. Marlatt.

Eleventh Annual Meeting, Columbus, Ohio, Aug. 18–19, 1899. President, C. L. Marlatt; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, A. H. Kirkland.

Twelfth Annual Meeting, New York, N. Y., June 22–23, 1900. President, Lawrence Bruner; First Vice-President, C. P. Gillette; Second Vice-President, E. H. Forbush; Secretary, A. H. Kirkland.

Thirteenth Annual Meeting, Denver, Colo., Aug. 23–24, 1901. President, C. P. Gillette; First Vice-President, A. D. Hopkins; Second Vice-President, E. P. Felt; Secretary, A. L. Quaintance.

Fourteenth Annual Meeting, Pittsburgh, Pa., June 27–28, 1902. President, A. D. Hopkins; First Vice-President, E. P. Felt; Second Vice-President, T. D. A. Cockerell; Secretary, A. L. Quaintance.

Fifteenth Annual Meeting, Washington, D C., Dec. 26–27, 1902. President, E. P. Felt; First Vice-President, W. H. Ashmead; Second Vice-President, Lawrence Bruner; Secretary, A. L. Quaintance.

Sixteenth Annual Meeting, St. Louis, Mo., Dec. 29–31, 1903. President, M. V. Slingerland; First Vice-President, C. M. Weed; Second Vice-President, Henry Skinner; Secretary, A. F. Burgess.

Seventeenth Annual Meeting, Philadelphia, Pa., Dec. 29–30, 1904. President, A. L. Quaintance; First Vice-President, A. F. Burgess; Second Vice-President, Mary E. Murtfeldt; Secretary, H. E. Summers.

Eighteenth Annual Meeting, New Orleans, La., Jan. 1–4, 1906. President, H. Garman; First Vice-President, E. D. Sanderson; Second Vice-President, F. L. Washburn; Secretary, H. E. Summers.

Nineteenth Annual Meeting, New York, N. Y., Dec. 28–29, 1906. President, A. H. Kirkland; First Vice-President, W. E. Britton; Second Vice-President, H. A. Morgan; Secretary, A. F. Burgess.

Twentieth Annual Meeting, Chicago, Ill., Dec. 27–28, 1907. President, H. A. Morgan; First Vice-President, H. E. Summers; Second Vice-President, W. D. Hunter; Secretary, A. F. Burgess.

Twenty-first Annual Meeting, Baltimore, Md., Dec. 28–29, 1908. President, S. A. Forbes; First Vice-President, W. E. Britton; Second Vice-President, E. D. Ball; Secretary, A. F. Burgess.

Twenty-second Annual Meeting, Boston, Mass., Dec. 28–29, 1909. President, W. E. Britton; First Vice-President, E. D. Ball; Second Vice-President, H. E. Summers; Secretary, A. F. Burgess.

Twenty-third Annual Meeting, Minneapolis, Minn., Dec. 28–29, 1910. President, E. D. Sanderson; First Vice-President, H. T. Fernald; Second Vice-President, P. J. Parrott; Secretary, A. F. Burgess.

Twenty-fourth Annual Meeting, Washington, D. C., Dec. 27–29, 1911. President, F. L. Washburn; First Vice-President, E. D. Ball; Second Vice-President, R. H. Pettit; Secretary, A. F. Burgess.

Twenty-fifth Annual Meeting, Cleveland, Ohio, Jan. 1–3, 1913. President, W. D. Hunter; First Vice-President, T. J. Headlee; Second Vice-President, R. A. Cooley; Secretary, A. F. Burgess.

Twenty-sixth Annual Meeting, Atlanta, Ga., Dec. 31, 1913–Jan. 2, 1914. President, P. J. Parrott; First Vice-President, E. L. Worsham; Second Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Twenty-seventh Annual Meeting, Philadelphia, Pa., Dec. 28–31, 1914. President, H. T. Fernald; First Vice-President, Glenn W. Herrick; Second Vice-President, W. E. Britton; Third Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Special Meeting, Berkeley, Cal., Aug. 9–10, 1915. (Officers same as for Twenty-eighth Annual Meeting.)

Twenty-eighth Annual Meeting, Columbus, Ohio, Dec. 27–30, 1915. President, Glenn W. Herrick; First Vice-President, R. A. Cooley; Second Vice-President, W. E. Rumsey; Third Vice-President, E. F. Phillips; Secretary, A. F. Burgess.

Twenty-ninth Annual Meeting, New York, N. Y., Dec. 28–30, 1916. President, C. Gordon Hewitt; First Vice-President, G. A. Dean; Second Vice-President, E. D. Ball; Third Vice-President, W. J. Schoene; Fourth Vice-President, T. J. Headlee; Secretary, A. F. Burgess.

Thirtieth Annual Meeting, Pittsburgh, Pa., Dec. 31, 1917–Jan. 2, 1918. President, R. A. Cooley; First Vice-President, W. E. Hinds; Second Vice-President, A. W. Morrill; Third Vice-President, G. M. Bentley; Fourth Vice-President, B. N. Gates; Secretary, A. F. Burgess.

Thirty-first Annual Meeting, Baltimore, Md., Dec. 26–27, 1918. President, E. D. Ball; First Vice-President, W. C. O'Kane; Second Vice-President, G. P. Weldon; Third Vice-President, E. C. Cotton; Fourth Vice-President, Franklin Sherman, Jr.; Secretary, A. F. Burgess.

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Proceedings of the Thirty-First Annual Meeting of the American Association of Economic Entomologists

The thirty-first annual meeting of the American Association of Economic Entomologists was held in Room 9, Gilman Hall, Johns Hopkins University, Baltimore, Maryland, December 26 and 27, 1918.

The meeting convened at 10.30 a. m., December 26, when the annual reports were presented and the address of the President was given.

The session was continued in the afternoon of the same day, and in the evening the Section on Apiculture met at 8.00 p. m., when a program of papers was presented.

At the morning session, December 27, a joint meeting of the Association and the Section on Horticultural Inspection was held.

The final meeting of the Association was held in the afternoon. The business proceedings of the Association are given in Part I of this report, and the address, papers and discussions appear as Part II.

The proceedings of the Section on Apiculture will be prepared by the Sectional Secretary and published as part of this report.

PART I. BUSINESS PROCEEDINGS

The meeting was called to order by President E. D. Ball, at 10.30 a. m., Thursday, December 26, 1918. About 100 members and visitors attended the sessions. The following members were present:

J. M. Aldrich, Washington, D. C.
R. H. Allen, Boston, Mass.
E. D. Ball, Ames, Iowa.
P. T. Barnes, Harrisburg, Pa.
G. G. Becker, Fayetteville, Ark.
G. M. Bentley, Knoxville, Tenn.
S. W. Bilsing, College Station, Texas.
M. W. Blackman, Syracuse, N. Y.
W. E. Britton, New Haven, Conn.
A. F. Burgess, Melrose Highlands, Mass.
August Busck, Washington, D. C.
D. J. Caffrey, Hagerstown, Md.
W. W. Chase, Atlanta, Ga.
Mel T. Cook, New Brunswick, N. J.

E. N. Cory, College Park, Md.
E. C. Cotton, Columbus, Ohio.
C. R. Crosby, Ithaca, N. Y.
J. J. Davis, West Lafayette, Ind.
G. A. Dean, Manhattan, Kan.
J. E. Dudley, Jr., Madison, Wis.
E. P. Felt, Albany, N. Y.
S. W. Frost, Arendtville, Pa.
A. B. Gahan, Berwyn, Md.
Philip Garman, College Park, Md.
C. P. Gillette, Fort Collins, Colo.
W. H. Goodwin, Riverton, N. J.
H. A. Gossard, Wooster, Ohio.
T. L. Guyton, Harrisburg, Pa.
C. H. Hadley, Jr., Bustleton, Pa.
T. J. Headlee, New Brunswick, N. J.
P. H. Hertzog, Hightstown, N. J.
A. D. Hopkins, Washington, D. C.
J. S. Houser, Wooster, Ohio.
L. O. Howard, Washington, D. C.
J. A. Hyslop, Washington, D. C.
T. H. Jones, Baton Rouge, La.
Max Kisliuk, Wilmington, N. C.
O. A. Larson, Logan, Utah.
R. W. Leiby, Raleigh, N. C.
A. C. Lewis, Atlanta, Ga.
Z. P. Metcalf, West Raleigh, N. C.
Harold Morrison, Washington, D. C.
W. C. O'Kane, Durham, N. H.
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R. C. Osburn, Columbus, Ohio.
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P. J. Parrott, Geneva, N. Y.
Alvah Peterson, New Brunswick, N. J.
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W. S. Regan, Amherst, Mass.
R. R. Reppert, Blacksburg, Va.
W. A. Riley, St. Paul, Minn.
J. M. Robinson, Auburn, Ala.
V. I. Safro, Louisville, Ky.
J. G. Sanders, Harrisburg, Pa.
E. D. Sanderson, Ithaca, N. Y.
E. R. Sasscer, Washington, D. C.
W. J. Schoene, Blacksburg, Va.
W. M. Scott, Washington, D. C.
L. M. Smith, Blacksburg, Va.
T. E. Snyder, Washington, D. C.
L. A. Stearns, Leesburg, Va.
T. B. Symons, College Park, Md.
F. M. Trimble, Primos, Pa.
G. W. Underhill, Blacksburg, Va.
R. H. Van Zwaluwenberg, Hagerstown, Md.
Joe S. Wade, Washington, D. C.
W. R. Walton, Washington, D. C.
J. L. Webb, Washington, D. C.
L. P. Wehrle, Ithaca, N. Y.
W. B. Wood, Washington, D. C.

PRESIDENT E. D. BALL: You will please come to order. The first business on the program is the report of the Secretary.

REPORT OF THE SECRETARY

The total membership of the Association at the time of the last annual meeting was 501, divided as follows: active 145, associate 306, and foreign 50. At that meeting four associate members resigned, and twenty-two were transferred to active membership. During the year four associate members have been dropped from the rolls and three active, seven associate and two foreign members have died. Seventy-one associate members were elected at the Pittsburgh meeting.

The present membership totals 553, divided as follows: active 164, associate 340, and foreign 48. The net gain for the year has been 50 members.

On July 15, 1916, Mr. A. T. Gillanders, one of our foreign members, was stricken with heart failure and died at Oxford, England.

This information did not reach the Secretary until April of this year which accounts for the lateness of this notice.

On February 17, 1918, Charles A. Hart died at his home at Urbana, Ill. He had been associated with the Illinois State Laboratory of Natural History and the Illinois State Entomologist's office for many years, and was one of our older active members.

On March 13, 1918, W. H. Harrington died at Ottawa, Canada. He has been an associate member for many years and his systematic work in Hymenoptera and Coleoptera was of recognized merit.

On April 11, 1918, Lieut. Vernon King, an associate member of this Association, was killed in an air battle in France when the machine in which he was flying with a pilot was attacked by three enemy scout machines. He was formerly employed by the United States Bureau of Entomology at Wellington, Kan., and was highly respected by all who knew him.

He joined the British Army soon after the Great War began and saw service in the Dardanelles campaign and later in France.

On July 4, 1918, Lieut. John W. Bradley, an associate member, died as the result of an aeroplane accident at Dayton, Ohio. Prior to the war he was an assistant at the Gipsy Moth Laboratory of the Bureau of Entomology, Melrose Highlands, Mass. He had completed his training and received his commission shortly before the accident occurred. He was a young man of great promise.

On July 21, 1918, Lieut. W. H. Hasey, an associate member, was killed in action in France while serving in the United States Infantry. He was a young man who had been trained in entomology at the Massachusetts Agricultural College, and carried on spraying and tree surgery work in Eastern Massachusetts.

On August 25, 1918, Dr. G. Leonardi, of the Royal Scuola di Agricoltura, Portici, Italy, a foreign member, died at Ventimiglia, Italy. He was well known for his work on Coccids.

On September 10, 1918, H. O. Marsh, an active member, died at Chester, N. J. Most of his active work was conducted for the Bureau of Entomology and many of his publications were issued by that Bureau.

On September 26, 1918, S. C. Vinal, an associate member, died of pneumonia at Cambridge, Mass. He was just beginning a career which promised a brilliant future as an entomologist.

On October 8, 1918, A. D. Duckett, an associate member, died of influenza. He had been employed several years by the United States Bureau of Entomology.

On November 2, 1918, Frederic Knab, an associate member, died at Washington, D. C. He had been an assistant in the Bureau of Entomology for many years and was custodian of the Diptera in the United States National Museum.

His work on Diptera, particularly Culicidae, is well known to all entomologists.

On December 15, 1918, Lieut. A. H. Jennings, an active member, died at Camp Shelby, Miss., from injuries by being knocked down by an automobile. He had done much valuable work on mosquitoes both in the United States and in the Canal Zone, Panama.

The Pacific Slope Branch held its third annual meeting March 28–29, 1918, at the branch laboratory of the California State Insectary at Alhambra, Cal. Twenty-nine members and visitors were present. An excellent program was presented and an opportunity given for field inspection of entomological work. The proceedings were published in the June number of the JOURNAL OF ECONOMIC ENTOMOLOGY.

During the past year there has been a moderate sale for Banks Index to the Literature of Economic Entomology. It has been necessary to bind 300 additional copies in order to meet future calls and this expense, together with postage and insurance, has been met from 1918 sales. The financial statement shows a balance of $46.92 in the treasury to the credit of this account.

Three hundred dollars is still due the Association fund on account of the Index, but it is expected that this can be reduced somewhat during the coming year.

At the last annual meeting it was voted that the dues of officers and enlisted men, members of this Association in the United States or allied armies or navies, be remitted until the close of the war.

This has been done in a few cases, but owing to the uncertainty concerning the status of many of the men, and contradictory reports that were received it was impossible to conform to the instructions of the Association in every case. The proper adjustment will be made with all our soldier and sailor members and each will receive full benefit of the action of the Association.

Remission of dues does not include subscription to the JOURNAL OF ECONOMIC ENTOMOLOGY.

The Secretary was also instructed to prepare an honor roll. It has been impossible to do this with any degree of accuracy. The following roll (see page 126), is submitted. It is doubtless imperfect in some respects, but is the best that can be done under the circumstances.

THE JOURNAL OF ECONOMIC ENTOMOLOGY

There has been a considerable reduction in the subscription list of the JOURNAL during the past year, and it has been necessary to curtail expenditures as much as possible in order to prevent a large deficit.

During 1917, 572 pages were published in the JOURNAL; during 1918, 494 pages were published. Even with this reduction in the amount of printing, the income from the JOURNAL has not been sufficient to pay expenses. The available balance at the end of the year 1917 has been exhausted and it has been necessary to use Association funds in order to keep the bills paid. At the annual meeting at Pittsburgh, the Secretary was authorized to transfer, not to exceed $200, from the Association funds for use in connection with the JOURNAL. It has been necessary to do this and $105.09 of this amount has been expended. Prices on nearly everything in connection with publishing the JOURNAL have increased greatly. The cost of printing was increased early in the year and a further increase of 25 per cent went into effect October 1. Printing is the largest single item of expenditure, but the cost of mailing, cost of postage, and nearly everything else has been advanced during the past year. It is impossible to attempt to meet these expenditures for the coming year by increasing the subscription price of the JOURNAL for the year 1919, as it is necessary to quote prices to subscription agencies and dealers five or six months prior to the beginning of the year and after these prices are fixed and published, it is impossible to revise them. For the coming year it will be necessary to reduce the size of the JOURNAL and in all probability draw on Association funds to make up the deficit.

Beginning with the year 1920, the subscription price of the JOURNAL should be increased by not less than 50 cents or more than $1 per year. The exact rate should be decided before July 1, 1919. This will give time to determine whether production prices will be maintained, advanced or decreased, as conditions become more normal.

ASSOCIATION STATEMENT

Balance in Treasury, December 7, 1917		$588.87
By amount received from dues, 1918		508.00
By amount received from interest in Malden National Bank		13.20
By amount received from interest of $100 Liberty Bond		4.12
Paid stenographic report 1917 meeting	$91.76	
Buttons, 1917 meeting	10.73	
Postage	41.00	
Printing programs, etc.	77.24	

Telegraph and express	$1.29	
Transfer to JOURNAL fund	200.00	
Clerical work, Secretary's office	35.00	
One-half salary of Secretary	50.00	
Returned check	2.00	
	$509.02	
Balance, December 10, 1918	605.17	
	$1,114.19	$1,114.19
Balance deposited as follows:		
Melrose Savings Bank	$157.42	
Malden National Bank	447.75	

JOURNAL STATEMENT

Balance in Treasury, December 7, 1917		$189.27
By amount received from subscriptions, advertising, etc., 1918		2,063.58
By amount received from Association account		200.00
By amount received as interest on bank deposit		5.13
Paid for stamps	$52.42	
express	2.68	
printing	1,872.84	
Telegraph	1.43	
Half-tones	135.15	
Miscellaneous supplies	3.00	
Insurance	20.55	
Clerical work, Editor's office	65.00	
Clerical work, Secretary's office	60.00	
Salary, Editor	100.00	
One-half salary of Secretary	50.00	
	$2,363.07	
Balance, December 10, 1918	94.91	
	$2,457.98	$2,457.98
Balance deposited in Malden, Mass., National Bank	$94.91	

INDEX STATEMENT

Balance in Treasury, December 15, 1917		$15.51
By amount received from sales to December 10, 1918		188.00
Paid for binding	127.89	
postage	10.00	
insurance	18.70	
	$156.59	
Balance, December 10, 1918, Deposited in Malden, Mass., National Bank	46.92	
	$203.51	$203.51

SUMMARY

Balance on Index Account	$46.92
Balance on Journal Account	94.91
Balance on Association Account	605.17
One 4¼ per cent Liberty Bond	100.00
	$847.00

Respectfully submitted,

A. F. BURGESS,
Secretary.

After a brief discussion it was moved that the report be accepted and the financial part referred to the Auditing Committee; also that the honor roll submitted by the Secretary be published in a prominent place in the JOURNAL and that suitable mention be made of the services of other members of the Association, not in the Army or Navy, who contributed their efforts to win the war.

PRESIDENT E. D. BALL: The next report is that of the Executive Committee, but there is no special report to make. The place of meeting was changed by the American Association for the advancement of Science, consequently we thought it necessary to make a similar change.

SECRETARY A. F. BURGESS: In connection with the changing of the place of meeting, I will say that late in the fall several members suggested that we hold an independent meeting at Cornell University on account of the probability that Baltimore would be crowded at this time. The Executive Committee decided, however, that it would be best to hold the meeting at Baltimore. Conditions have improved very much recently, and it is doubtless fortunate that this arrangement was made as it developed that Cornell University could not make convenient arrangements for holding the meeting during the vacation period. There is, however, a desire on the part of some of the members to hold a meeting at Ithaca when convenient arrangements can be made.

PRESIDENT E. D. BALL: The next on the program is the report of the Entomologists' Employment Bureau. (Dr. Hinds, who has charge of the Bureau was not present at the meeting, and his report did not arrive until after final adjournment, therefore no action could be taken on it. The report is inserted, however, to complete the record.)

REPORT OF ENTOMOLOGISTS' EMPLOYMENT BUREAU FOR YEAR OF 1918

During the past year the work of the Bureau has been much affected by war conditions. The drafts placed many of the men on our rolls in army service and thus reduced the number of eligible candidates for the few positions which were reported to us. The restrictions of war economies evidently reduced the number of positions for which candidates were sought. There has been a notable change in both these phases of our work since the middle of November.

During the past year fourteen (14) men have enrolled, including the reënrollments. Several men have been placed but we know that our record of placements is very incomplete.

Ninety-one (91) references have been made between possible employers and employees, and two hundred and ten (210) letters written in the Bureau work.

FINANCIAL STATEMENT FOR YEAR OF 1918

Receipts:		
Dec. 26, 1917, Cash on hand	$47.10	
1918 enrollments, fourteen, at $2.00	28.00	
Total		$75.10
Disbursements:		
April 9, 1918, Paid J. P. Bell (stenographer)	6.80	
Aug. 24, 1918, Post Publishing Co. (printing)	2.00	
Oct. 28, Paid C. E. Posey (stenographer)	11.20	
Dec. 21, Paid Mrs. J. W. Dooley (stenographer)	3.00	
Dec. 24, Paid W. E. Hinds, postage for year	6.30	
Dec. 24, Paid W. E. Hinds, entomologist for envelopes and second sheets furnished for year	2.50	
Total		31.80
Balance, cash on hand		$43.30

Respectfully submitted,

W. E. HINDS,
In Charge.

PRESIDENT E. D. BALL: We will now listen to the report of the Committee on Nomenclature.

REPORT OF THE COMMITTEE ON NOMENCLATURE

The Committee on Nomenclature has had nothing referred to it during the year, and no suggestions or requests have been made regarding the adoption or change of common names. The members of the committee feel, however, that considerable work should be done along this line in order to insure stability and uniformity in common names. For the purpose of making a slight contribution towards this end, the following names have been suggested by members of the committee, and the committee recommends their adoption:

Laspeyresia molesta Busck	Oriental Peach Moth
Pyrausta nubilalis Hubn.	European Corn Borer
Rhagoletis cingulata Loew	Banded Cherry Fruit-fly
Rhagoletis fausta O. S.	Dark Cherry Fruit-fly

Respectfully submitted,

W. E. BRITTON,
EDITH M. PATCH,
GLENN W. HERRICK,
Committee.

Report was accepted and the recommendations adopted with the exception of the tobacco worm, *Crambus* sp., which was referred back to the committee for further consideration.

PRESIDENT E. D. BALL: The report of the Committee on Index to Economic Entomology will now be in order.

REPORT OF THE COMMITTEE ON THE PUBLICATION OF THE INDEX OF AMERICAN ECONOMIC ENTOMOLOGY

The successful completion of the Index for 1905 to 1914, at a tota cost of $1,212.90, was reported at the last meeting, at which time there was a balance against the work, after deducting receipts from sales, of $284.49. The Secretary of the Association, under date of December 9 last, states that thirty-seven copies have been sold and paid for during the year and as the stock of bound copies on hand was running very low, 300 more copies were bound. He adds that the expense of binding, insurance and postage has made it impossible to reduce the $300 outstanding which was borrowed from the Association funds. There is, however, to the credit of the index fund at the present time $46.92 and if a reasonable number of sales can be made during the coming year, this debt can be considerably reduced.

A recent letter from Doctor Howard, Chief of the Bureau of Entomology, states that he and a number of other men in the Bureau, think it very desirable that a five year Index, covering the years 1915 to 1919, should be prepared. Furthermore he will arrange to have the compilation made and as the value of the Index depends to a very considerable degree upon the promptness of its publication, it seems advisable that the compilation be commenced early enough so that the Index will be complete or practically so by the end of the next calendar year, thus making it possible to issue the volume in March or April, 1920.

This Index covers a five-year period and in order to be on the safe side, it has been estimated that there would be about three fourths as many references as in the volume covering the preceding decennium. This would make a work of about 250 pages. Tentative figures by the printer, based on current prices, indicate that the cost of the completed work would be approximately the same as that of the other volume; in other words, the advance in prices would be approximately offset by the smaller size of the volume.

The committee therefore recommends that it be continued and authorized to start the work in 1919, along substantially the same lines as were followed in the preparation of the preceding Index, and that the editorial board of the JOURNAL OF ECONOMIC ENTOMOLOGY be authorized, in its discretion, to proceed with the publication of the Index and to fix, as heretofore, the price of copies.

Respectfully submitted,

E. P. FELT,
A. F. BURGESS,
W. C. O'KANE,
W. E. BRITTON,
W. E. HINDS,
Committee.

On motion the report was accepted and the recommendations adopted.

PRESIDENT E. D. BALL: The next report is that of the Committee on War Service.

REPORT OF THE COMMITTEE ON WAR SERVICE BY ENTOMOLOGISTS

Your Special Committee appointed January 2, 1918, to bring to the attention of the federal authorities resolutions of the Association tendering to the War Department the technical services of entomologists in connection with camp sanitation, especially in the prevention of insect-borne diseases, begs to report that we met first in Washington, January 9–12, coming into conference with officers of the War Department most immediately responsible for the control of camp sanitation, submitting to the Department through them the resolutions passed by you at your Pittsburgh meeting, and taking such further steps towards realizing the purpose of these resolutions as seemed possible at the time; that we met again in Washington, April 5, to complete our arrangements with the Department; and that our business since that time has been conducted by correspondence only.

It appeared to us in the beginning that entomologists might be of important service to the armies of the United States in time of war by accepting such positions as might be offered them in the U. S. Sanitary Corps as experts in the study and control of insect pests, especially those which are carriers of contagious disease to our troops in camp and field; by acting as advisers to the sanitary officers of camps and cantonments in their respective territories; and by engaging, as their other employments might permit, in a careful investigation of sanitary problems in which infestation by insects was an important factor.

At our first meeting we had a conference with Doctor Howard and examined the correspondence which he had already had with the Surgeon-General's office relative to the appointment of entomologists to positions in the Sanitary Corps. The committee planned at the outset to coöperate with the U. S. Bureau of Entomology, which, by reason of its location, affiliations, and opportunities for personal communication and conference, was in position to advise and negotiate and to make recommendations, both general and specific, to the War Department. Indeed, the Bureau had already done much to influence the policy of the Medical Department with respect to the appointment of entomologists as sanitary officers.

Although the responsible officers of the Medical Department were by no means a unit as to the need of entomologists in official relation to army sanitation, some of the more important of them being, indeed, evidently of the opinion that the medical officers of the Sanitary Corps were, or would presently become, entirely competent to handle insect problems in a practical way without expert aid from entomologists, there were still enough whose minds were open to conviction to give the Bureau of Entomology a fair opportunity to bring fact and argument to bear, with the result that E. H. Gibson, R. Gies, W. B. Herms, A. H. Jennings, and D. L. Van Dine were commissioned as captains in the Sanitary Corps, L. H. Dunn, and W. H. White as lieutenants in that corps, and G. F. White as a captain in the Medical Corps. Several entomologists were taken into the army and given non-commissioned positions, six of them as sergeants and one as a corporal. In the navy John W. Bailey was sent to the Navy Medical School and recommended for a commission, but was later transferred to the army and would have received a commission within a few days except for the signing of the armistice; and O. H. Basseches, who was in the Officers' Training School, would have received a commission in the Veterinary Corps except for the same reason. Several entomologists who applied for service in the Medical Corps were sent to the Yale Army Medical School, and were being trained for possible commissions in the Medical Corps when hostilities were terminated. One member of the Marine Corps, C. D. Duncan, was promoted to pharmacist's mate and had charge of all the entomological sanitation at Quantico; and five privates were assigned to entomological sanitary work in their camps.

The Bureau has also maintained, throughout the period of the war, thorough cooperation with the Surgeon-General's office in the matter of *experimental* work on insect problems. Practically all of the work on the body-louse has been conducted in the Bureau or through a committee of the National Research Council of which Doctor Howard is chairman; and reports of these investigations have been sent, as fast as ready, to the Surgeon-General's office. By direction of the Surgeon-General, arrangements were made with Major F. B. Granger for coöperative experiments in certain phases of the itch-mite problem. A large part of this investigation was carried on in coöperation with the Quartermaster's Department, and, as a result, extensive reports were made on the value of laundering and dry-cleaning processes against the body-louse. A very promising coöperation was established with several officers of the Chemical Warfare Service. In one line of research experiments were made to learn the fumigation value of all gases used in chemical warfare, and in another, to determine the effect in controlling vermin of substances used to protect the body against the poisonous gases.

Indirectly the Bureau was asked to render considerable service to officers handling sanitary problems by means of the duplicated proceedings of a class formed for the study of the entomology of disease, hygiene, and sanitation. Copies of these proceedings were sent to every camp library in the United States at the request of the Camp Library Association, and were also sent personally to many officers.

In its own direct operations your committee was somewhat hampered by the undeniable fact that, although representing an important national association, we were, in a military sense, simply citizens offering assistance to army officers presumably competent to the discharge of their duties, however special and numerous these might be, and by the further fact that we had in the beginning no definite information of conditions existing at that time in our own camps and cantonments which we could submit as convincing evidence that the services of entomologists were actually needed in the American Army. It seemed, therefore, to be our first duty to arrive, if possible, at a knowledge of these conditions, and we proposed a system of unofficial visits by the entomologists of certain selected states to camps and cantonments within their territories, with a view to ascertaining whether insect problems were really being handled successfully, and to serving as unofficial advisers to the medical officers in charge if occasion were found for such advice. We had in view, also, the fact that a critical inspection of entomological conditions in the neighborhood of military establishments was an immediate duty of entomologists interested in the protection of the health of the people in their states against insect-borne diseases, and for this no special authorization was needed. We proposed, of course, to send to the Surgeon-General informal reports of observations made and recommendations which seemed to be called for.

Through the willing and interested courtesy of Colonel F. F. Russell, of the U. S. Medical Corps, who wrote us under date of February 23, "I think that we all agree that a survey made in this way is a very desirable and satisfactory solution of one of our difficulties," an arrangement of this character was made, and letters of introduction were given, at our request, to the various medical officers concerned, of which the following is an example:

From the Surgeon-General, U. S. Army

To The Division Surgeon, Camp Sherman, Ohio

1. This will introduce to you Professor Herbert Osborn, of Ohio State University, Columbus, Ohio. Professor Osborn is one of the best known economic entomologists in the country. It is believed that direct coöperation between you and Professor Osborn will result in the prompt correction of sanitary difficulties due to insect pests,

especially since Professor Osborn has, through his state connections, considerable power and authority over extra-cantonment conditions which cannot be reached directly by you.

By direction of the Surgeon-General:

(Signed) F. F. RUSSELL,
Colonel, Medical Corps, U. S. A.

It was our intention to choose in the first instance a few typical, widely separated, camps and cantonments such as might be supposed to give us a fair idea of conditions throughout the country, and letters were requested for entomologists in the states of Arizona, Colorado, Alabama, Illinois, Ohio, New York, and New Hampshire. Owing no doubt to the terrific pressure on all military offices in Washington at the time, the letters called for were not actually issued until the last days of May, and reports of surveys were received by the committee at various dates from June 8 to August 9, and these were forwarded to Washington soon thereafter. In the meantime, the vacation season had so far dispersed the official entomologists, including the chairman of this committee, that no further progress was made on this program.

We scarcely need say that the visiting entomologists were cordially welcomed in every case; that every facility and assistance was rendered them in making their observations; and that their comments and suggestions, when matters of any importance came to light, were received with evident appreciation of the service rendered. Full reports were received by us concerning seven different camps, and brief general statements concerning two others.

It was evident from these reports that the entomological problems relating to the camps and cantonments were being handled much more successfully than those relating to adjacent areas outside. There was little found, indeed, concerning interior conditions to which serious exception could be taken. In one southern camp houseflies were common in mess-halls and kitchens, although all buildings had been thoroughly screened, the trouble here being due to an imperfect fitting of the screens to window openings, and to an unsuspected breeding place of flies in livery stables about a mile away, the surroundings of which were not as clean as they should have been although all manure was being removed from the stables every day. In one or two camps somewhat infested by lice and other parasites, the officers were taking the proper steps to abate the nuisance.

The following are fair examples of the reports received, one relating to Camp Sherman, in Ohio, and the other to Camp Devens, in Massachusetts:

Camp Sherman.—"As I had letters to Surgeon Robinson from Dr. Freeman and, to Colonel Allen, Division Surgeon, from the Surgeon-General's office, I received a very cordial welcome from these officers and believe that the information I secured is thoroughly reliable and that we can depend upon the men in charge of sanitation at the camp to coöperate in every practical way in the matter of utilizing any information that we may be able to furnish concerning most effective plans for insect control. In this first visit I think the main accomplishment was the establishment of cordial relations as a basis for coöperation in the future.

"From all of the facts that I learned, it appears that the health conditions in this camp have been excellent and there have been practically no cases of disease which could be attributed to insect carriers. Typhoid has been practically eliminated as a result of inoculation, but the disease is more or less prevalent in the vicinity of the camp and the public health service in coöperation with the State Board of Health is making a vigorous campaign for the reduction of flies and the elimination of all possible sources of fly-breeding and contamination.

"The camp itself has disposed of stable waste very effectively by daily distribution to the surrounding farms—so effectively, indeed, that it was said that there was more difficulty in disposing of the stable wastes from the city proper. The local officer considers that they have this fairly well in hand now, and expects improvement as they get their organization more effectively at work.

"Apparently they have had no annoyance from mosquitoes. There is no malaria in the locality nor has there been for many years. However, they recognize the possibility of malarial cases and the need of guarding against *Anopheles*. The mosquito situation will need some attention, but, considering the conditions, I believe the local authorities are fully justified in putting their main effort at present on the suppression of flies rather than undertaking any extensive operations against the possible mosquito-breeding localities. In case any injury comes from this course it will be desirable either to provide drainage or else to keep the ponds and canal pockets filled with water and stocked with fish or mosquito-destroying insects to avoid danger from this source.

"No rats have been troublesome at the camp, and were reported not abundant in the town. No flies, body-lice, chiggers, 'punkies,' buffalo-gnats, or other pests have occasioned trouble so far. On the whole, I think the sanitary conditions may be considered in good shape, and the officers in charge are exceptionally energetic and efficient in their operations."

Camp Devens.—"I visited this camp five times in the course of the summer, and each time have looked over conditions in a general way.

"The reception accorded me by the Division Surgeon and his assistants had been exceedingly friendly. There was an evident desire on the part of the officers to take full advantage of any help that might be offered them and a full willingness to explain in detail the measures that they were carrying through to control insect pests within the camp. One could not ask for a more cordial and open-minded reception.

"Camp Devens is situated in a sandy region made up of many small knolls originally covered, for the most part, with small, scrubby tree growth. There are several small ponds within the limits of the camp, and along one border is a river which, so far as I have observed, has slow movement. Most of the area has excellent natural drainage, with the exception of some of the ponds and especially the borders of the river.

"The sanitary officers carried out considerable drainage measures, especially in some wet areas adjacent to the base hospital and a similar area near the large parade ground. Drainage of a rathe stagnant pool, somewhat filled with brush, was not undertaken and probably was not feasible. Drainage of the extensive stagnant water along the border of the river could not be undertaken, since there was no fall. Apparently, conditions were such that mosquitoes might become a serious nuisance, but throughout this season very few mosquito larvæ could be found in any of the ponds or in the stream. Enlisted men with whom I talked said that they were not bothered at all with mosquitoes. In the course of the summer the camp received a detachment of more than two thousand negroes from the south, and examination by the division surgeon's officers showed that a large proportion of these negroes were carriers of malaria. For this reason I feared that there would be danger of an outbreak of malaria in the camp if *Anopheles* should show up, but nothing of the kind took place.

"Considerable oiling was done by sanitary squads. Oil was applied by knapsack pumps and by drip cans. However, to attempt to control the mosquitoes by oiling in some of the swamp areas, especially along the river, would be difficult.

"The fly proposition was handled carefully by the sanitary officers. Garbage was removed daily to a station at one margin of the camp, where the cans were emptied and washed. The garbage from the emptied cans was hauled away by a contractor. Facilities for thoroughly cleaning the cans were inadequate. They were supposed to be cleaned with scalding water, but the boiler for providing the hot water was too small.

"Outside each mess-hall garbage cans were placed within screened cages. Most of these cages were provided with fly-traps. In the opinion of one of the assistants attached to the division surgeon's office, garbage was handled more satisfactorily when the cans were placed on an open platform, provided the cans are removed daily. On the open platform there is less opportunity for bits of garbage to remain unnoticed in corners. Also, in his experience, screened receptacles for garbage soon ceased to be fly-proof.

"Horse manure was collected daily; was carted to a loading station near the camp and was there loaded into freight cars and hauled away. For the most part the stables were kept clean. There was no evidence of extensive breeding of flies in stable manure.

"Occasionally men were received in the cantonment who were infested with body-lice, but apparently such cases were always detected and the lice destroyed. There

was no general infestation of body-lice at any point in the cantonment, so far as I could learn.

"Bedbugs became a nuisance in certain officers' quarters, and were difficult to control because of the type of building."

The control of outside conditions usually required the coöperation of local authorities or state boards of health, and this was sometimes obtainable and sometimes not. In one of our Illinois camps, for example, a prairie stream which carried away camp sewage was regularly policed and all the farm premises within half a mile were kept quite clean of breeding places for flies; in another all waters in which mosquitoes might breed were regularly oiled by sanitary squads sent out from the camp; but in a third no attention whatever had been paid to the immediate environment, although the camp had been established within a quarter of a mile of an extensive swamp in which mosquitoes, including *Anopheles*, began to breed in immense numbers as soon as the season opened, neighboring outhouses were in filthy condition, and a sawmill employing a number of workmen near the camp was without toilet facilities of any kind. Even here, however, there were no untoward consequences, an unusually long drouth drying out the swamp and no cases of disease traceable to house-flies occurring.

It was in the improvement of these outside conditions that our entomologists might have been most active and useful; and if the war had continued we should doubtless have brought this fact clearly to your notice, with a view to a plan of more general and effective coöperation another year.

The subject of after-the-war work by entomologists lies, of course, outside the duty of this committee, but we take the liberty, nevertheless, of calling your attention to a discussion of it which appeared as an editorial in the December number of the JOURNAL OF ECONOMIC ENTOMOLOGY, and to express the approval of the committee as a whole of the suggestions made therein.

S. A. FORBES,
E. P. FELT,
W. C. O'KANE,
Committee.

MR. E. P. FELT: Dr. Forbes, chairman of this committee, is unable to be present, but the report which he has drafted has been examined by the other members of the committee and with the exception of a few minor changes, is in the same form as he originally submitted it.

A general discussion of this report followed, and as there seemed to be work along war or after the war lines, that could be done, it was voted that the report be accepted and the committee continued.

PRESIDENT E. D. BALL: We will now listen to the report of the Committee on Entomological Investigations.

MR. W. J. SCHOENE: A circular letter has been sent to the entomologists and as soon as returns come in, these will be compiled and copies forwarded to the members. By vote of the Association the report was adopted.

PRESIDENT E. D. BALL: We will now listen to the Committee on the Proposed Amendment to the Constitution.

REPORT OF THE COMMITTEE ON PROPOSED AMENDMENTS TO THE CONSTITUTION

The chairman of the Membership Committee of last year submitted proposals for the amendment of the constitution which would result in reclassifying the membership and provide, in addition to classes already recognized, for the election of fellows and honorary fellows. The principal object of the proposed change was to provide for the admission to active membership of a considerable number now listed as associate members. The committee, in view of the somewhat unsettled conditions of the present, recommend that developments be awaited and action deferred.

Respectfully submitted,

E. P. FELT,
W. C. O'KANE,
J. G. SANDERS,
Committee.

On motion the report was adopted.

PRESIDENT E. D. BALL: We will now take up any miscellaneous business.

MR. T. J. HEADLEE stated that he was opposed to decreasing the size of the JOURNAL and suggested that a committee be appointed to secure additional finances so that the present size could be maintained.

SECRETARY A. F. BURGESS stated that under ordinary conditions the JOURNAL had been able to meet its expenses, but with the increased cost of everything connected with its makeup during the past two years, it was not possible to finance the JOURNAL upon its present resources. The rates for 1919 had been made last June to subscription agencies and it was therefore impossible to increase the price for 1919. The desired result could be brought about by increasing the subscription list or by decreasing the pages of the publication and drawing funds from the treasury of the Association. The subscription price for the year 1920 should be increased.

MR. E. P. FELT stated that if there were enough members willing to subscribe $10 apiece, the 1919 issue could be carried through without decreasing the number of pages, but arrangements should be made for increasing the subscription price for 1920. A motion was made that the JOURNAL be kept at its present size.

PRESIDENT E. D. BALL stated that at the present time 88 members of the Phytopathological Society were each subscribing $10 per year for a period of ten years to finance their Journal and that the annual subscription to their Journal was $4. He expressed surprise that some of the active members of the Association were not subscribing for the JOURNAL, and thought that all members should show their loyalty to the publication by supporting it at this time.

MR. J. G. SANDERS stated his belief that active members should subscribe.

SECRETARY A. F. BURGESS remarked that there were a considerable number of both active and associate members who did not subscribe to the publication.

MR. RAYMOND OSBURN asked if it would not be well to make the dues include subscription to the JOURNAL.

SECRETARY BURGESS stated in reply that the reason for keeping the two accounts separate was because of the possible difficulty with the Postoffice Department in connection with the second-class mailing privilege.

MR. OSBURN stated that he had dealings with another publication and that they had no trouble along this line. He further stated that another society with which he was connected had published a journal which cost more than their available income, but it had been found quite easy to secure contributions from the members of the society so that the indebtedness was paid off.

MR. T. J. HEADLEE stated that he was strongly opposed to any action which would compel members to subscribe to the JOURNAL if they did not wish to do so, and thought that the publication should be so valuable that all would be anxious to support it.

Upon motion it was voted that the JOURNAL be kept at its present size for the coming year, and that a committee of three be appointed by the President to devise means of carrying this into effect.

At the Thursday afternoon session during the consideration of the President's address, a motion was made by T. J. Headlee that a Standing Committee on Entomological Policy of ten members be appointed, the terms of office being so arranged that two should retire each year and their successors be elected for a term of five years. After general discussion this motion was laid upon the table for consideration at the final business session. Discussion of this motion by various members will be found under the discussion of the Presidential address. The following committees were appointed by the President:

Nominating Committee.—C. P. Gillette, J. G. Sanders and E. P. Felt.

Committee on Resolutions.—W. D. Pierce, W. J. Schoene and E. C. Cotton.

Auditing Committee,—W. R. Walton and J. S. Houser.

Committee on Journal of Economic Entomology.—T. J. Headlee, Herbert Osborn and W. E. Britton.

Before adjournment the President appointed Mr. C. P. Gillette to fill the vacancy on the Council of the American Association for the Advancement of Science, due to the absence of Mr. R. A. Cooley. A general discussion followed in connection with recommending members of this association to become Fellows in the American Association

for the Advancement of Science. It was voted that the representatives of this association on the council of the American Association for the Advancement of Science be requested to present to that association the names of active members whom they consider should be made fellows.

At the Friday morning session during the discussion of the paper on the European Corn Borer, the following motion was made and unanimously carried: That this Association endorses the utmost possible measure of eradication of the European Corn Borer and further endorses the proposition of asking Congress for sufficient appropriation to undertake immediately a competent campaign of eradication, under Federal direction. As this was a joint session of the Association and the Section on Horticultural Inspection, it became necessary to nominate a Chairman of the Section for the year 1919. Mr. E. C. Cotton was nominated for Chairman and Mr. J. G. Sanders was elected Secretary of the Section.

At the final session, the following business was transacted:

PRESIDENT E. D. BALL: I will now call for the report of the Committee on Auditing.

REPORT OF AUDITING COMMITTEE

The Committee on Auditing has examined the books of the Secretary and found the accounts to be correct.

J. S. HOUSER,
W. R. WALTON,
Auditing Committee.

By vote of the Association the report of the committee was accepted.

PRESIDENT E. D. BALL: We will now hear the report of the Committee on Resolutions.

REPORT OF THE COMMITTEE ON RESOLUTIONS

The Committee on Resolutions has the honor to report the following resolutions:

We believe that our Association and our profession has just crossed the threshold of a new era in scientific effort. As we look back over the record of the past year we find that our numbers have been decreased by several deaths, some in the service of our own glorious nation, and some in the service of our great Allies, while others have died in the simple performance of their life-time duties. We glory in all that they have done for our science, and in these few words wish to pay tribute to each of them for the work that he accomplished.

We desire to call attention to the faithful services of our Association's officers of the past year, and the welcome address of our retiring President; to the courtesies of the Johns Hopkins University, and the Committee of Arrangements of the Association.

Finally we look forward toward the building up of a firm foundation for economic entomology.

Therefore be it resolved:

1. That the American Association of Economic Entomologists, deeply grieved over the loss of its associates, Capt. Allen H. Jennings, Lieut. Vernon King, Lieut. J. W. Bradley, Lieut. W. H. Hasey, A. T. Gillanders, Dr. G. Leonardi, Chas. A. Hart, W. H. Harrington, H. O. Marsh, S. C. Vinal, F. Knab, and A. B. Duckett, does take this occasion to express to the world and to their families the esteem in which they were held.

2. That we are proud individually and collectively of every man who has served our nation or our Allies in the great struggle for freedom, no matter what may have been the particular field of action which befell him. Each did his part to the best of his ability.

3. That we as entomologists realize that our science is so intimately related to many other sciences and professions as to require frequent contact, and are determined that we will direct our efforts more and more toward obtaining effective cooperation with all other associated and interested groups of workers in all our problems.

4. That the science of entomology requires greater coördination in all its branches; and that we do hereby propose tentative discussion with other entomological organizations throughout the world, with the ultimate purpose of a world-wide union of entomological effort.

5. That a change is desirable in the Constitution of this Association, so that we may have a more stable organization and may develop year by year deeper seated general policies for our science.

6. That for the present the most available method of accomplishing the three resolutions above is the formation of a committee on policy, to be composed each year of the President, Secretary of the Association, the Editor of the JOURNAL and five members elected for five years each, one retiring each year; that the committee as initially composed contain one each elected for terms of one, two, three, four and five years; that this committee on policy have as its functions the directing of all policies of the Association and its various undertakings, the formulation and fostering of great entomological policies for the profession, and the working out of a more perfect coördination of scientific effort among entomologists and between entomologists and other professions; and finally that this committee on policy become by constitutional amendments an integral part of the Organization.

W. DWIGHT PIERCE,
W. J. SCHOENE,
E. C. COTTON,
Members of Committee.

MR. W. D. PIERCE: I have two motions to put before the house at the proper time in order to make these resolutions effective.

By vote of the Association the report of the committee was adopted.

PRESIDENT E. D. BALL: We will now listen to the report of the Committee on Membership.

REPORT OF COMMITTEE ON MEMBERSHIP

In the report of the Membership Committee presented at the New York meeting of this Association, it was recommended that the Committee prepare a statement quoting that part of the constitution referring to membership, together with the records and the minutes of other action that the Association has taken from time to time,

relating to qualifications for membership and in addition, any further statement that may be necessary to clearly interpret the existing policy of the Association as to standards of membership, with the intent that this statement, after consideration by the Association, be printed on the back of the blank application for associate membership.

In response to the above request your committee submits the following statements:

Article II of the Constitution of the American Association of Economic Entomologists reads as follows:

Section 1. All economic entomologists, horticultural or apiary inspectors, employed by the General or State Governments, or by the State Experiment Stations, or by any agricultural or horticultural association, and all teachers of economic entomology in educational institutions and other persons engaged in practical work in economic entomology, may become members.

Section 2. The classes of membership shall be active, associate and foreign. Active membership shall be conferred only on persons who have been trained in entomological work and whose practical experience or published papers have evidenced their ability to conduct original investigations in economic entomology.

Section 3. Associate membership may be conferred on persons who have done general or practical work in entomology and who have by published papers or otherwise, given evidence of their attainments in such work.

Section 4. Foreign membership shall be honorary and shall apply only to members residing outside of the United States and Canada.

Section 5. Associate and foreign members shall not be entitled to hold office or to vote.

Section 6. Membership, other than foreign membership, may be conferred at any regular meeting by a two-thirds vote of the members present upon recommendation of the Committee on Membership, after a regular application endorsed by two active members has been filed with the Secretary.

Section 7. Foreign members may be proposed in writing by any active member and their names shall be acted upon by the Committee on Membership and the Association, as in the case of other members.

The past policy of the Association has been to admit to associate membership anyone who occupies some position in economic entomology and who is vouched for by two active members, and it is desirable for all associate members who seek advancement to active membership to submit to the committee a statement relative to their education, experience, and publications and when possible to likewise submit published papers that the committee may be in a position to carefully consider promotions. It is further suggested that active members aid the committee by recommending such associate members as they deem worthy of advancement and in so doing to submit data to enable the committee to act intelligently on the application, such nominations to be made at least three months prior to the annual meeting.

It has heretofore been the policy of the Association to elect to active membership from the list of associate members only.

The committee understands that as a general rule at least, active membership in the American Association of Economic Entomologists should be limited to those doing enough individual teaching or practical work so that economic entomology occupies a considerable share of their time and it can be no reflection upon anyone if he be denied membership simply because his activities are along other lines. Your committee has been governed to a certain extent by a ruling of the American Association for the Advancement of Science which is to the effect that members elected to active membership in our Association will become eligible to fellowships in the American Association for the Advancement of Science so long as we continue to be careful in the selection of our active members.

Foreign membership shall be honorary, according to the constitution, and nominations for foreign membership, together with full information concerning the publica-

tions and other qualifications of the nominee shall be filed with the chairman of the committee at least three months before the annual meeting.

The following members are recommended for advancement to active rank:

A. C. Baker
A. W. Baker
M. W. Blackman
W. H. Brittain
A. E. Cameron
G. C. Crampton
William Davidson
I. W. Davis
H. F. Dietz
R. W. Doane
H. E. Ewing
H. Fox
Philip Garman
Hugh Glasgow
J. E. Graf
Geo. P. Gray
P. A. Glenn
C. H. Hadley, Jr.
L. Haseman
W. P. Hayes
J. R. Horton
D. W. Jones
T. H. Jones
W. V. King
H. H. Knight
G. H. Lamson, Jr.
M. D. Leonard
Q. S. Lowry
A. L. Lovett
P. Luginbill
L. S. McLaine
A. L. Melander
F. H. Mosher
F. B. Milliken
H. Morrison
J. A. Nelson
Raymond C. Osburn
H. T. Osborn
R. R. Parker
T. H. Parks
A. Peterson
C. H. Popence
C. H. Richardson
W. S. Regan
L. P. Rockwood
W. A. Ross
A. F. Satterthwait
E. H. Siegler
L. B. Smith
J. N. Sumners
E. H. Strickland
W. B. Wood
M. P. Zapp

The following are recommended to associate membership:

Charles S. Beckwith
J. C. Bridwall
H. M. Brundrett
A. B. Black
C. P. Clausen
Mitchell Carroll
T. H. Cutrer
D. L. Dolbin
P. W. Fattig
C. L. Fluke, Jr.
W. T. Ham
M. E. Kimsey
A. O. Larson
G. M. List
D. B. Mackie
D. E. Merrill
Shonosuke Nakayama
J. H. Newton
H. R. Painter
H. B. Parks
D. B. Penny
F. W. Poos
B. A. Porter
J. M. Robinson
H. J. Ryan
R. R. Reppert
R. C. Smith
O. I. Snapp
Antony Spuler
B. G. Thompson
R. C. Treherne
A. W. Young
F. N. Wallace
E. E. Wehr
L. P. Wehrle
G. W. Underhill
James Zetek

That W. O. Hollister be reinstated to associate membership.

The following members have sent in resignations and the committee recommends their acceptance: A. B. Champlain, B. P. Gregson, Simon Marcovitch, W. E. Pennington and J. M. Stedman.

Ten members elected a year ago have paid no dues and seventeen additional associate and one active member are in arrears. The committee recommends that these members be notified by the Secretary that failure to promptly pay back dues will result in their being dropped from the rolls of the Association.

The list of members recommended for promotion to active membership is considerably longer than at any previous meeting but the committee, after careful consideration of recommendations and data received, believes all are fully eligible. The committee has received data which have enabled it to consider the eligibles to better advantage than heretofore and it does not understand that the large number of promotions should be taken as a precedent and that in future years the number raised to active rank may, so far as at present determinable, be much reduced.

Possibly other members may be eligible to active membership this year, but it is often impossible for the committee to properly make selections except where complete data have been furnished. Requests for the necessary data were sent to every associate member of this Association and of the 349 members of this rank only 57 sent in the information requested. The committee wishes to again request members who desire to become active and who have not already sent in these data to do so in order that their names may be given the proper consideration next year.

Respectfully submitted,

J. J. Davis, *Chairman*,
W. E. Britton,
T. J. Headlee,
Committee.

By vote of the Association the report of the Committee was adopted.

Mr. W. C. O'Kane: I move that the motion which was made yesterday concerning the proposed Committee on Policy be taken from the table. Carried.

Mr. W. D. Pierce: I wish to propose the following substitute motion:

That a Committee on Policy be formed to consist of the President, Secretary and Editor of the Journal, as ex-officio members, and five members to be elected for five-years terms, one retiring each year; and in order that this retirement be accomplished in the initial formation of the committee by electing one member for a full five-year term, one for four years, one for three years, one for two years, and one for one year; and that the duties of this committee shall be the originating and directing of all policies of the association and its various undertakings, the formulation and fostering of great entomological policies for the profession, and the working out of a more perfect coördination of scientific effort among entomologists and between entomologists and other professions."

It was voted that the motion of Mr. Pierce be substituted for the original motion, and it was then adopted.

President E. D. Ball: I will now call for the report of the Committee on Journal of Economic Entomology.

REPORT OF SPECIAL COMMITTEE ON THE JOURNAL OF ECONOMIC ENTOMOLOGY

GENTLEMEN OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGY:

Your Special Committee on the JOURNAL begs leave to report on the problem of financing the JOURNAL as follows:

1. That the order of the Association to maintain the JOURNAL during 1919 at its 1918 size be interpreted to mean "maintained in quality of printing, illustrations, and approximate matter contained but not necessarily at the same or a larger number of pages or the same quality of paper." That details of this interpretation be left to the business manager and editorial board who have so successfully handled these matters in the past.

2. That the $600 which the estimates show to be necessary in addition to funds already available, be raised in the following ways:

A. By a draft on the general funds of the Associations to the amount of $500.

B. By subscriptions among the membership of the additional sum of $100, which shall be raised as follows: and with the understanding that moneys as contributed shall be repaid in the form of dues and subscription to the JOURNAL at the prices current for the years concerned, beginning next year:

a. By subscriptions during this meeting from the floor.

b. By subscriptions through correspondence.

3. That after expiration of present agreements the price of JOURNAL subscriptions to non-members be raised fifty cents a year.

Respectfully submitted,

THOMAS J. HEADLEE,
HERBERT OSBORN,
Committee.

At the request of the President the Secretary explained that it would probably be possible during the coming year to transfer $500 from the Association fund to the JOURNAL fund. This would enable the JOURNAL to be kept at its present size if $100 additional could be raised. The matter of fixing the price of the JOURNAL for the year 1920 was fully discussed and it was voted that the report of the committee be accepted and the recommendations adopted with the understanding that the price of the JOURNAL would be fixed by the executive committee.

PRESIDENT E. D. BALL: I will now call for the report of the Committee on National Museum.

REPORT OF COMMITTEE ON NATIONAL MUSEUM

The Committee on National Museum was appointed two years ago to study the conditions in the United States National Museum for the purpose of offering means for promoting and providing for adequate development of the division of insects. At our last annual meeting this committee reported on the needs of the Division of Insects, United States National Museum, and suggested means for promoting and assisting the work of this institution.

Owing to the unsettled conditions the past year, your committee has nothing further to report at this time.

Your committee recommends that a committee on National Museum be made a standing committee of this association, such a committee to keep in close touch with the entomological work of the United States National Museum, to foster its work, create sentiment towards the museum and in other ways make for the accomplishment of the ideals suggested in the last report of the present committee.

It is suggested that this committee consist of five members to be elected at each annual meeting, to hold office for a period of five years, and that they shall conduct their tasks in coöperation with the similar committee of the Entomological Society of America. Your present committee believes it desirable to make the committee representative of the United States and especially is this expedient if it becomes desirable for the committee to bring pressure on the legislative sources; and that the chairman of said standing committee hold office for a period of years since this would make for greater continuity of policy.

Respectfully submitted,

J. J. DAVIS,
E. P. FELT,
HERBERT OSBORN,
E. D. BALL,
R. L. WEBSTER,
Committee.

MR. A. L. QUAINTANCE: I would like to inquire whether the Honorary Curator of Insects of the Museum will be an ex-officio member of this committee. I think the Bureau should be represented and I would like to ask whether this is the intention of the committee.

PRESIDENT E. D. BALL: It occurs to me that one of the purposes of this committee is to assist in securing funds and equipment for the Museum and it might not be advantageous to the Curator if he was a member of this committee.

By vote of the Association the report was accepted and recommendations adopted.

PRESIDENT E. D. BALL: I will now call for the nomination of JOURNAL officers by the advisory committee.

MR. C. P. GILLETTE: The advisory committee would nominate the present officers to succeed themselves for the ensuing year:

E. P. Felt, Editor.
W. E. Britton, Associate Editor.
A. F. Burgess, Business Manager.

By vote of the Association the recommendations were adopted.

MR. W. D. PIERCE: I wish to propose amendments to the Constitution. These amendments are designed to modify the Constitution so that the Committee on Policy which has been provided for the coming year may become a permanent organization at the beginning of next year.

PROPOSED AMENDMENTS TO THE CONSTITUTION

ARTICLE III

SECTION 1. Amend by striking out the second sentence which reads: "The above officers shall act as the Board of Directors and shall pass on any urgent matters that cannot be deferred until the annual meetings."

Add the following section:

SECTION 2. There shall be a Board of Directors to be composed each year of the President, Secretary, and Editor of the JOURNAL, as ex-officio, and five members elected for five years each, one retiring each year. The Chairman shall be elected by the Board.

BY-LAWS

Article II. to be amended to read as follows:

SECTION 4. The publication of the JOURNAL OF ECONOMIC ENTOMOLOGY shall be entrusted to an Editor, an Associate Editor and a Business Manager, nominated by the Board of Directors. The members of this committee shall have an advisory relation to the above constituted Editorial Board.

SECTION 5. The Board of Directors shall have as its functions the originating and directing of all policies of the Association and its various undertakings, the formulation and fostering of great entomological policies for the profession, and the working out of a more perfect coördination of scientific effort among entomologists and between entomologists and other professions.

PRESIDENT E. D. BALL: This matter will come up for consideration at the next annual meeting and I will appoint the following committee to consider the amendments and report at that time: P. J. Parrott, W. A. Riley and George A. Dean.

MR. W. E. BRITTON: As Associate Editor of the JOURNAL I would like to ask all members to send in news items which may be appropriate to print as current news. It is difficult to secure these items, but if the members will coöperate this part of the JOURNAL will be made more interesting.

PRESIDENT E. D. BALL: The report of the Committee on Nominations is now in order.

REPORT OF THE COMMITTEE ON NOMINATIONS

The Committee on Nominations begs leave to report as follows:

For President: W. C. O'Kane.
First Vice-President: A. G. Ruggles.
Second Vice-President: H. J. Quayle.
Third Vice-President: E. C. Cotton.
Fourth Vice-President: W. E. Britton.

Committee on Nomenclature, 3 years: Z. P. Metcalf.

Committee on Entomological Investigations, 3 years: P. J. Parrott.

Membership Committee, 3 years: E. R. Sasscer.

Council of the American Association for the Advancement of Science: H. A. Gossard and C. P. Gillette.

Director Employment Bureau: W. E. Hinds.

Advisory Board, JOURNAL OF ECONOMIC ENTOMOLOGY: W. J. Schoene and S. A. Forbes.

Committee on Entomological Policy: E. D. Ball, 5 years; Herbert Osborn, 4 years; W. D. Pierce, 3 years; J. G. Sanders, 2 years; and G. A. Dean, 1 year.

Committee on United States National Museum: J. J. Davis, Chairman, 5 years; V. L. Kellogg, 4 years; E. P. Felt, 3 years; Herbert Osborn, 2 years, and E. D. Ball, 1 year.

Respectfully submitted,

C. P. Gillette,
J. G. Sanders,
E. P. Felt,
Committee.

Mr. E. C. Cotton: I move that the report be adopted and the Secretary be instructed to cast the unanimous ballot of the association for the candidates named. Carried.

The ballot was cast by the Secretary and the officers named were declared elected by the President.

Secretary A. F. Burgess: I move that the next annual meeting be fixed at the same time and place as that chosen by the American Association for the Advancement of Science, unless it is deemed advisable by the committee on policy to change the time and place. Carried.

Secretary A. F. Burgess: I would like to say that the paper that has been passed around shows a subscription of $160 for the Journal fund. I think this indicates very strongly the interest of the members of the Association in their publication. Upon motion the meeting was adjourned.

PART II. PAPERS AND DISCUSSION

THE PRESIDENT'S ADDRESS

ECONOMIC ENTOMOLOGY—ITS FOUNDATIONS AND FUTURE

By E. D. Ball, *Ames, Iowa*

We are passing, today, through an epoch-making period. Decisions are being made and to be made, that will profoundly affect, not only the rights of the individual, but the destinies of nations and the entire superstructure of our political and social universe. We are witnessing, today, the birth of what one of our gifted leaders has christened—the modern world.

Our country has passed in a short year, from an isolated and indifferent entity, interested only in her own development, into a nation that has resolutely taken her place on the forum of democracy. Like a moth out of a chrysalis, she has broken her shell of contentment and

emerged, at first faltering and feeble, but rapidly gaining in strength, until her wings have expanded and she has risen and circled out over the fields of this world to be. The moth cannot fold her wings and return to the caterpillar stage on the single plant; she is now of the air and of life and must go on. Neither can our nation return to her isolation. She has taken her place in the lists as the champion of democracy—the establishment of the rights of the individual and the brotherhood of man, and as such, she must and should remain.

Our society has grown with the nation's growth, and has contributed to it. We have expanded as she has extended her domain and we must be prepared to go on with her, and take our place with her in the new order of things. If our society is to be true to its traditions, she must remain in an advanced position of leadership. This will require a broadening of our scope and interest, a strengthening of forces and ideals, a stronger administrative organization and a carefully chosen leadership to meet the requirements of our new and greater responsibility.

The Economic Entomologists are to be congratulated on the fact that they represent the oldest society in America organized for the promotion of an economic phase of agriculture. Thirty years ago, when this association was formed, agriculture was an art with slightly scientific ambitions, in a nation that was groping and struggling to find herself.

Thanks to the energy, enthusiasm and almost prophetic vision of the old warriors, Economic Entomology became crystallized and definitely established on scientific foundations long before our sister societies in Plant Pathology, Animal Nutrition, Agronomy, and Horticultural Science were even possible. We were extremely fortunate in the original band of warriors, crusaders after truth, whose self-sacrifice and devotion made this society possible. They were, for the most part, men whose love of nature had drawn them to the work and held them there despite discouragement, ridicule and lack of support. Truly they founded well, and on that foundation this association has grown in prominence and power, in numbers and influence, as well as in material prosperity, ever keeping pace with the progress of the nation.

The spread of the San José scale and the development of the nursery inspection laws in its wake, brought the entomologist into prominence, gave him financial support and opened the way for an extremely rapid development. No other of our sister societies has ever received such an impetus.

We wonder sometimes, however, when we compare the work of this society with its closest relative, the Phytopathologists, whether the wealth and power, brought to us by the apparent opportunity of the

inspection service, has not been our undoing—our destruction, rather than our salvation. Have not the opportunities been too great, positions too easy to obtain, educational standards and requirements too low for even the present good of the science, to say nothing of the foundations which we must build for the future? When we compare the relative training and preparations of Pathological and Entomological staffs in the same institutions and note that the Pathologists have about three Doctorates to the Entomologists' one, note in fact, that the Doctorate is as common in Pathology, as the Master in Entomology, we begin to feel anxious for the future of our beloved science. If we should go farther in our analysis and compare the type of work that is being put out today, by the two organizations, we might feel even more alarmed for the future of our science. We should not, however, be discouraged; we should rather read a message of warning and an opportunity for salvation. The Pathologists have been passing through the stages and struggles of the early days of this society. They are laying the foundations for their science. They are, today, winning the support of the people. They are small in numbers, but great in inspiration, in interest and zeal. They are better trained because the opportunities were few and the standards high. There has been little encouragement to enter the field, except for the real lover of the science. They are very largely a band of choice spirits. Today they are facing the problems that prosperity brings. May our good wishes go with them, in the hope that they may profit by our experience, and meet prosperity with their standards still high and their faith undimmed.

What, then, is the standing of the Entomologists, as they prepare to take their place in the modern world? A society whose efforts and achievements have been recognized the world around, a society that has not only laid the foundations of insect control for America, but for every corner of the earth. We speak, today, of America as a "world power." The Economic Entomologists of America have been a "world power" for a generation. Our "fourteen principles" have long since been accepted by all nations. Is it possible, you ask, for a society with such a record, to be outstripped by one just out of its swaddling clothes? Let us hope that it is not. Let us do more than hope; let us make sure that the traditions of the past may be continued and enhanced in the work of the future. Let us examine the situation from every angle, weigh each factor, recognize error and shortcoming, if such exist, and lay our foundations for an even more brilliant future, founded on the achievements of a glorious past.

There are three fundamental factors to consider in estimating the productive power and possibility of development of a scientific organi-

zation. They are its foundations—its attitude towards truth—and its vision.

Let us measure ourselves by these standards. As a society we have been felicitated and congratulated, our valuable works enumerated, our contributions heralded, our recommendations adopted, until we have become complacent and self-satisfied. Optimism and self-congratulation are good and will carry one far, but sometimes they lead into by-paths of ease and forgetfulness, to that relaxation of aggressiveness and vigilance that comes with age, while youth, vigor and the critical attitude that comes with introspection and unfulfilled ambition, would have guided away from the danger and held us to the path of progress.

We have also been handicapped in establishing our foundations, by the fact that we are dealing with by far the largest single group of living things. Not only are they countless in number, but infinite in variety and complexity, reaching out in their adaptations into every other form of life, involving in their reactions, almost the entire animate and inanimate world. With a field so vast and varied, so manifestly impossible to cover, it has probably been easier to be contented with the superficial and the immediately important, rather than to search deeper for the foundation stones upon which, alone, an enduring science could have been builded.

Twenty years ago a bomb shell was dropped into our midst, by a president who dared to question the very foundations of our economic science. His exposition of "The Lassier-faire Philosophy" raised a storm of protest and denunciation. Predictions were freely made, that it would cut off our financial support and cripple our development. We are still strongly supported and if anything, too popular! Whether for good or evil, that presidential address is the one that remains vivid and outstanding in the memory of the writer. It has tempered many an exuberance; it has been an antidote to dogmatism and a cure for complacency. In questioning our foundations it caused us to pause and consider them as seriously at that time, as we must do again today.

What, then, is the status of our foundations? Have we completely solved the problem and mastered the intricate relations of a single injurious insect, or have we skimmed the surface of the knowledge of thousands? Have we exhausted the possibilities of discovery of one of the factors of insect development or control? Do we know the relative limits of egg production of our injurious species? Are the number of eggs produced relatively stable or influenced by environmental factors? Do we know the number of annual generations of our insects and the factors that control those numbers? Do we understand the periodicity

of insect appearance and the factors that bring it about? When shall we forecast insect abundance as we now forecast the weather and crop production? Do we understand climatic and ecological factors in insect distribution? Have we lived with these insects as Agassiz lived with the fishes or Audubon with the birds, or have we observed them in the stated hours of an office day? Why has the chinch bug, once seriously injurious in northern Wisconsin, abandoned the state? Why has the box-elder bug moved to the northeast? Why has the corn-root worm moved north-west? Why is the codling-moth extraordinarily abundant in the arid regions, while the potato bug is there unknown? What caused the disappearance of the Rocky Mountain locust? Why does temperature accelerate the development of one insect and retard that of another? Why does a single puncture of one insect cause more injury to a plant than a hundred punctures of another species?

Beneath these and a thousand other problems, are the principles that underlie our science. They involve many factors and interrelations with all the sciences. They have been approached from many angles and through the medium of thousands of different species. Their ramifications extend through an overwhelming mass of literature, not only entomological, but extending into many related sciences. The solution of even a single one of these problems involves long and protracted study, the following out of many related factors, interpretation of many obscurities, the mastery of a voluminous literature and finally the organizing of the completed whole into a form from which a simple deduction can be drawn. Such a problem is worthy of a life's effort—of years of preparation, joined to fruitful years of investigation, finally to be crowned with the satisfaction of a work well done.

It is for us to study our educational system and see if we are offering the proper training for such a task. Are we offering or requiring a major amount of broad and fundamental training in Physics and Chemistry, in Botany and Zoölogy, in Physiology and Geology, in Bacteriology and Genetics, with a minimum of requirements in our special line and those of fundamental character? On such a foundation as that, a lifetime of study and research can be builded, and the structure remain stable and upright.

In many institutions of today, however, the tendency has been to narrowness and specialization, to reduce the number of foundation courses, and increase the number of so-called practical courses, to train in the art, instead of the science. A recent catalogue outlined a course with twelve studies in the major subject and only three in fundamentals. A graduate of that course might be ready to meet almost any superficial question of general entomological knowledge, but he would be woefully lacking in the fundamentals that would prove the enduring

foundation for exhaustive research. Is it not possible that if every special entomological course in this country were abolished and aspirants for entomological honors were required to take a general science course, with broad requirements, that the entomology of the future would be the gainer thereby?

Our mad scramble to turn out nursery inspectors and extension specialists, walking encyclopedias of miscellaneous information, some of which is false and more of which is doubtful, may tend to popularize entomological science, but will never ground it. The extension slogan, "that it will take ten years to carry the researches already made to the people," is the most pernicious doctrine of our generation. Granting that it is true, and it probably is, there still remains the fact that much of that which is now being carried will have to be corrected or contradicted, when the truth is known, and that the whole trend of education and extension is away from that serious and fundamental research, which alone can reveal the truth for which we strive. One of the leading directors of Agricultural Research recently announced that he would prefer to select his men from a university where no agriculture as such, had been taught, than from an agricultural college where too much time had been devoted to the art, and too little to the science; arguing, and no doubt justly, that the research man with the broad foundation could easily acquire the art of a particular agricultural problem, while a narrowly trained man would never acquire the broad scientific foundation, necessary for its solution.

In this connection, it would be well for us to consider that the science of entomology is so tremendously broad and intricate, that it is impossible for any man to longer attempt to master all the details. If we recognize this, we shall hereafter give broader fundamental training in entomology, in order to meet the general requirements and then encourage group specialization. In such a limited field, one may still hope to obtain a mastery. Under past methods, a single experiment station worker has undertaken problems involving practically all orders of insects, with the result that it has been impossible for him to master the literature of any one. Many times his so-called researches have only carried the investigation of problems to the same position that had been reached by previous workers, there to be dropped and another taken up. On the other hand, some of the most fruitful workers in the past have been able to confine themselves to one or at the most, two or three fields, have mastered the literature and the methods of procedure, in their restricted groups, and have contributed greatly to the sum total of human knowledge.

In the olden days, we had the savant that knew all things, the philosopher that reasoned all things, and even later, the scientist that

dabbled in all science; today we have entomologists, tomorrow we will have group specialists, who will not be afraid to say that there are many other fields in entomology, to them unknown.

A stream can rise no higher than its source. The future of entomological science depends upon its foundations and those foundations depend upon the work of the present generation and the inspiration transmitted to those to come.

The Attitude Towards Truth

The attitude of the society towards truth should always be receptive—more than receptive, eager. We should, as an organization and as individuals, welcome constructive criticism. We should go even further than this, and provide the machinery of analysis and organization that would encourage and even solicit criticism. The link which binds the members of this society together is that we are all searching after truth. There can be no legitimate place in such an organization for the perpetuation of error.

There has, however, grown up in this society, a tradition that anyone who disturbed the peace and harmony of this continuous output of error was a knocker and a trouble-maker. To such an extent has the propaganda been carried, that the only form of criticism that is now tolerated, is that of syntax and etymology, while entomology suffers from the constant repetition of misinformation and ancient error.

We need criticism—constructive criticism if possible, but criticism—honest criticism, in any form, should be welcomed and encouraged. Many mistakes of observation or errors of deduction, known by many workers to be such, are still current in our literature, and are being reiterated and republished to this day, due to the attitude of this organization, towards the individual who would criticise.

The demand for entomological information has been so great, and the general informational bulletin so much in vogue, that many of us have grown lax in the matter of giving proper credit for material used. Even in scientific papers or technical journals, the material is appropriated and used without credit. Much of this material is antiquated and too much of it erroneous. Anyone using such material cannot plead previous publication by any one else, as justification. He becomes responsible for the error and should be held accountable.

When entomology was a struggling science, when economic problems were many and the workers few, there may have been justification for this laxity. There can be none now. Because Riley figured grasshoppers laying eggs in an impossible position, fifty years ago, is no justification for anyone claiming to have investigated the grass-

hopper, to perpetuate that error, and yet it has only been within a few years that it was publicly corrected. In that same publication, other errors of observation were recorded, and are still being perpetuated and republished without credit, to this day. When a question of their correctness is raised, they refer you back to Riley. Riley did a wonderful work, which we all recognize and revere. He also made many errors, which he, himself, would have corrected, if he had had an opportunity to repeat the work. Loyalty to his great name, to truth and to the science of entomology, which we are all striving to establish, all demand that these errors be eliminated. Let Riley be credited with what he did, his errors corrected, and let later workers be credited with their contributions.

This society should have a permanent committee on publications, who should formulate rules and regulations, the same as we have rules for systematic work, to which economic publications should conform. These rules should provide for three classes of economic publications:

First: Popular matter, claiming no originality and therefore no credit. In such publications it should not be necessary to give credit, although in many cases, reference to the source will strengthen the appeal.

Second: Publications purporting to contain original matter. In such publications it should be required that the status of knowledge be set forth in a preliminary review, in which due credit is given to each contributor, and this followed by the contribution of the writer, or else, that the whole subject be discussed with due credit to previous work, and that there be a summary in which the original contribution of the writer is specifically claimed and set forth.

Third: Summaries and reviews, in which every worker be specifically credited with his contribution.

A strong and carefully thought-out set of regulations, along these lines, to be enforced by the society, and administered by a strong and responsible committee, would have a powerful influence in strengthening, condensing, and unifying our economic literature. If all economic publications would adopt them, and the attention of experiment stations and other sources of publication be called to their provisions, it would be of inestimable value in clarifying our knowledge.

The tremendous accumulation of economic literature, much of it admittedly popular, but in most of which no differentiation is made between contribution and compilation is one of the serious and growing handicaps to progress. This society should spend much less time in listening to detailed reports of minor experiments and more time in discussing ways and means of solving the problems of the future. Catalogues, bibliographies, indices and summaries, are imperative, if

this enormous mass is to be assimilated and profitably used. More funds of this association should be used for this purpose and more influence brought to bear, on sources of publication, so that offerings of this kind could find ready acceptance. The bibliography of Economic Entomology should be kept up to date, and arrangements made to bring the valuable contributions into a single bibliography.

The committee on publications might well be charged with the problem of reviewing past literature and fixing credit for at least major discoveries in our science. By a system of sub-committees and the use of specialists who already have a large part of this information, the task could be accomplished and every worker immeasurably benefited by the knowledge. The committee might well adopt the policy of requesting each living worker to set forth his own contributions to knowledge, asking him to go farther and classify them into major and minor groups. Overlapping claims and inaccuracies could be worked out, and the whole unified and correlated, in such a way as to make it highly valuable to every worker. It would require a certain amount of time and effort on the part of each individual, but there is, possibly, no more valuable piece of work that the ordinary individual could undertake, than to calmly sit down and measure the value of his own productions in a critical and impartial manner.

We need, also, to be more generous in our credit to assistants and helpers. Credit of this kind, joint authorship, or specific acknowledgment does not, in the least, detract from the credit of the individual, but rather enhances it. The days of feudalism, of the master and slave, are gone. It is pleasant to note that the customs of the Dark Ages are rapidly disappearing, and that the contributions of the third generation of our scientists are practically free from criticism in this respect.

There are many of the fundamental questions of the future that involve the effect of insect attack upon the host plant, whether it is the effect of egg deposition or of feeding puncture or both, whether it is mere mechanical injury or something injected, or whether the insect is a carrier of a definite disease. One plant disease is already known to be transmitted only by the puncture of a specific insect, others appear to be specifically transmitted, while others are transmitted by a number of insects or by other methods. Here is a tremendously important and interesting field, as yet almost unworked.

All of these problems require the coöperation of the Plant Pathologist and Physiologist, and for these and many other reasons, our relations with these societies should be the most cordial and mutually helpful. Many of the problems of the State Entomologist involve pathological and physiological factors, and in all of this work, the coöperation and assistance of these plant workers should be sought.

It is only when the closest coöperation and sympathy exists, that the greatest good can be accomplished. A joint meeting of the two societies each year, for the presidential addresses, would be a powerful factor in bringing about mutual sympathy and understanding.

Vision

Of all the fundamentals, the power to see the possibilities and opportunities of the future, is probably the greatest and possibly the rarest. Happily, however, a single leader may lead an army. A Moses, from his cradle in the bulrushes, led a nation to emancipation; a Columbus sailed on and on, towards a shore no eye had ever seen; a Foch could see through the smoke of battle, to the fields of battles and victories, yet to come. These, and a thousand others, have led because they could see beyond the present and accomplished, because they dared the unknown. Their vision and their faith were the creative powers that established the modern world.

It is America's boast, that yellow fever does not exist under the Stars and Stripes; that the Bubonic plague, the triple alliance of the rat, the flea and the bacillus, has been practically routed from civilization; that scabies, the scourge of the western range, has practically disappeared as a menace to the sheep industry; that the foot and mouth disease has been banished from our soil. Newell calls attention to the fact that the quarantine line of the Texas fever has steadily been pushed southward, until it has touched the Gulf, and will eventually disappear. These and other striking victories of scientific warfare have involved problems partially entomological, but have been accomplished largely through other agencies. Newell has already called attention to the eradication of the citrus canker, with its almost phenomenal success. The campaign against the barberry has met with a wonderful and almost unbelievable response. The spirit of conquest is in the air, and if the Entomologists are to carry their standard in the fore-front of this modern warfare against the enemies of old, they must search the rushes for a Moses.

Notable achievements are already to their credit. The cottony cushion scale has been subjugated, the gypsy and brown-tail moth compelled to intrench. The waves of molesting mosquitoes have been driven back and their bivouacs destroyed. The advanced spies of devouring hordes have been stopped at our shores. The pink bollworm is now in retreat. These and other achievements have been notable and worthy, but should be followed by even greater ones. The cottony cushion scale should not only be subjugated, but exterminated. The warble fly passes the greater part of its life in an exposed situation on the backs of the cattle. A concerted effort and a

thorough organization, with the power and push of American energy and ingenuity, would eliminate this pest in a single season. It would hardly be accomplished, before the gain in leather and increased production would have paid the cost. The codling-moth is restricted to the apple and one or two allied fruits and nuts for its existence. An organized force, taking advantage of short crops, by reason of frost or previous heavy bearing, could free an entire region in a single year. By rigid quarantine it could be held free, until adjacent regions received like treatment. Area after area could in this way be cleaned up, until this scourge was driven from our shores. The state of Texas offered $50,000 reward for a plan of control of the cotton-boll weevil. Three hundred claimed the prize, but none succeeded. This pest is entirely dependent upon the cotton plant for its existence, and as Newell has pointed out, if the nation would store cotton in advance and cease to grow the crop for a single year, its eradication might be accomplished. It would be even possible to divide the country into three districts, increase the crop production in one area, while it was eliminated for two seasons, in the others. In this way, it could be more certainly eliminated and still cotton produced.

There are many who will say that all of these things are impossible and we will grant that they are, but you will remember that it was impossible to build the Panama Canal, but a Goethals builded it. It was impossible to put a million men in France. Statistics showed that there were not trains enough to move them, nor ships enough to carry them. It was altruistic, but impossible. It was also proved to be impossible to feed them, even if they could have been placed there. There was overwhelming evidence to these conclusions, and yet these men and many more were placed on French soil and the food was there in abundance. The trouble with the statisticians was that they forgot the power of leadership and organization supported by the enthusiasm and self-sacrifice of a free people.

There are doubtless scores of other insect pests of prime importance, that have even more vulnerable spots somewhere in the armor of their development. It is only a question of finding it and organizing for the attack. The Economic Entomologists are weak in aggressive organization, to meet the conditions of today. They should have a strong and permanent executive committee, presided over by the strongest leader of our band. To this committee should be intrusted the organization of our efforts to the accomplishment of these ends. This committee should decide on the problems to be attacked, the method of operation, and the organization of public support and coöperation so essential to success. The society should change its rules, so that the president would serve for the year following his address and the ap-

pointment of his committees and thus actively assist in carrying out the policies that he proposed.

The Economic Entomologists will become more active and aggressive, if they fulfill their destiny and keep abreast of the progress of the modern world. They will broaden and strengthen their courses of instruction, insist on fundamentals and foundations in all branches. They will require longer and more adequate preparation for research and thus establish standards beyond reproach. They will welcome criticism, be generous in credit, seek coöperation; they will ally themselves with all forces that fight for the freedom of the earth from pest and disease. They will have faith to attempt the impossible and finally triumph, as do all forces that battle for truth and right.

At the close of the address a vote of thanks was extended by the association, after which the session adjourned.

Afternoon Session, Thursday, December 26, 1918, 2.40 p. m.

PRESIDENT E. D. BALL: We will now take up the first paper on the program, by T. J. Headlee, New Brunswick, N. J.

PRACTICAL APPLICATION OF THE METHODS RECENTLY DISCOVERED FOR THE CONTROL OF THE SPRINKLING SEWAGE FILTER FLY

(*Psychoda alternata*)

By THOMAS J. HEADLEE, Ph. D., *Entomologist of the New Jersey Agricultural Experiment Stations and State Entomologist*

INTRODUCTION

Except where trade wastes are discharged in sufficient quantities materially to affect the effluent, sewage purification is essentially a process of transforming chemically unstable compounds into those which are chemically stable, and a process of reducing the number of pathogenic organisms to the lowest possible point, to the end that the water which has been used as a carrier for the sewage matters may be discharged into streams without polluting them in such a way as to be a menace to human health. The transformation of the chemically unstable sewage compounds to the chemically stable is apparently a bio-chemical process. The society of animals and plants effecting this change apparently reaches its highest development in the sprinkling sewage filter. The broken stones of which the body of this type of filter is composed are more or less completely coated with a gelatinous and amorphous film in which live the millions of organisms which effect this transformation. The organisms concerned are representatives at least of Bacteria, Fungi, Protozoa, Nematoda, Rotatoria,

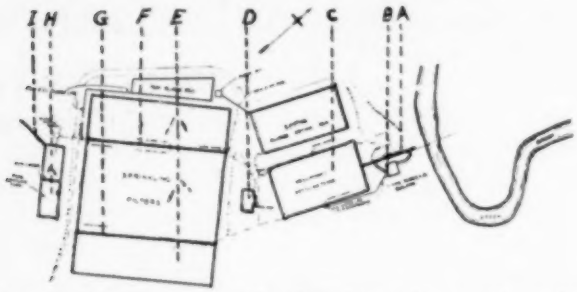


Fig. 1.—Diagram of the sewage purification plant where work against sprinkling sewage Filter Fly was carried out. Raw sewage enters at A, passes through B, C, D, E and H, and the purified effluent escapes through I. The flies are produced in E.

A—Stream of raw sewage; B—Screen for removing coarse matter; C—Preliminary settling tanks; D—Siphon dosing tanks; E—Sprinkling filters; F and G—Galleries leading the sewage into and out of the sprinkling filters; H—Final settling tanks; I—Stream of effluent.

Chætopoda, Crustacea, Arachidna, and Insecta. The exact part which each group of organisms plays in the process of sewage purification is still an unsolved problem. The *Psychoda* are, however, concerned in the reducing of the gelatinous and amorphous film, living in it and consuming it. The principal species of *Psychoda* found doing this work at the Plainfield sprinkling sewage filter is *Psychoda alternata*.

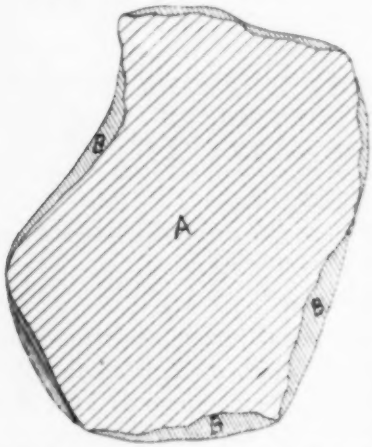
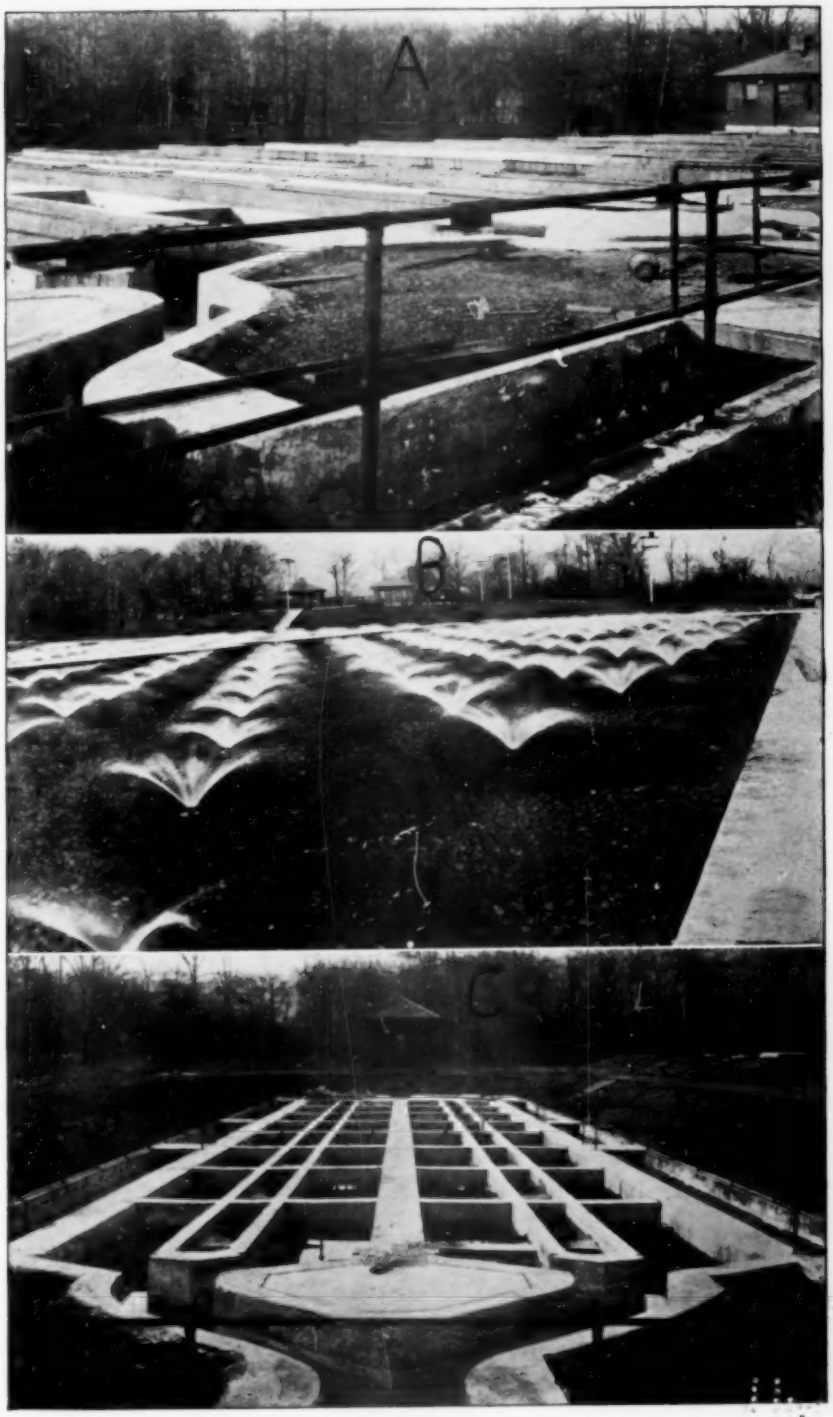


Fig. 2.—Diagram showing relation of film to stone. A, Stone; B, Film.

Nature and Extent of Injury

So far as the present studies have gone there is nothing whatever to show that the Sprinkling Sewage Filter Fly in any way damages or interferes with the efficiency of the society to which it belongs. The adult flies, however, emerging in enormous numbers throughout the fore-part and throughout the latter part of the warm season, fly or are wind-carried for a distance of at least three-fourths of a mile, penetrate the finest screens and fall into the food which is presently to be consumed by people. Knowing the source of these flies and seeing them in the food, is sufficient to convince the people concerned that almost any infection from which they may subsequently suffer has been brought to them by this agency and to cause them to file suits for damage against the concern or the municipality maintaining the sewage

Plate 1. General view of the preliminary settling tanks (A), the sprinkling filter (B) and the final settling tanks (C). Sewage passes through in the order named. The flies breed in the sprinkling filter.


A
B

purification plant from which they come. Whether these flies actually carry infection has never been determined, but the presumption that they do is not at all unreasonable.

Almost wherever sprinkling sewage filters are maintained these flies are produced and trouble of this kind is likely to occur.

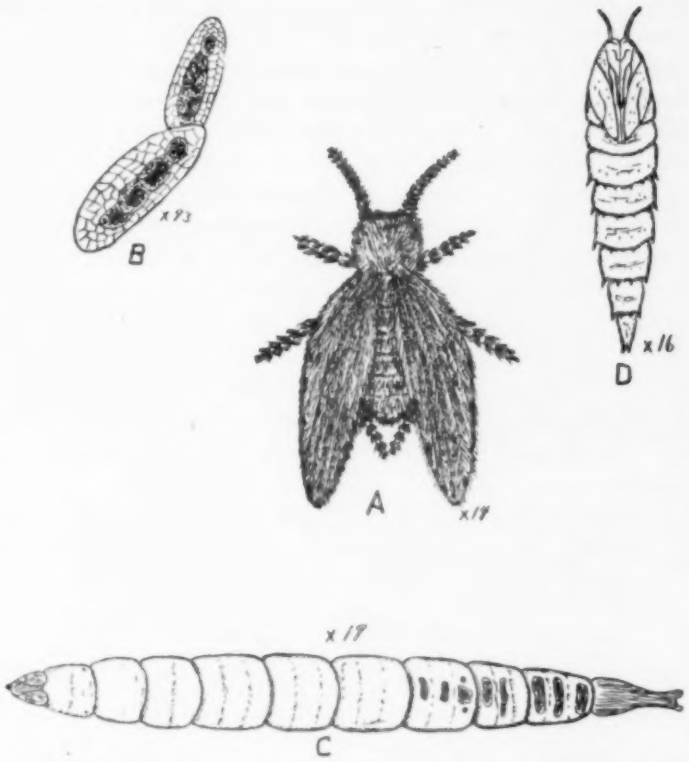


Fig. 3.—Life stages of the Sprinkling Sewage Filter Fly. A, Adult; B, Eggs (After L. Haseman); C, Larva; D, Pupa.

Life-History and Habits

The Sprinkling Sewage Filter Fly remains in the filter throughout the entire year, but to what extent breeding takes place in the winter time we are unable to say. Reproduction, however, occurred during the month of December, 1918.

The eggs are laid on the film. The young hatch and make their way into it. Here they establish themselves with the breathing tube projecting from the film surface and the body buried in it. In this position they feed and grow to maturity. Transformation to pupæ takes place in the film and the pupæ assume a position with their two breathing tubes sticking through the surface and the rest of their

bodies buried in the film. When pupation has been completed the front end of the pupal shell is burst open and the fly emerges.

The insect is not a strong flier and its movements from the filter are much influenced by the wind. It has the habit of resting on the undersides of the stones in the upper layers of the filter and upon the sidewalls of the filter itself. The life cycle may be completed in the summer in a minimum of a little less than 12 days. As a matter of fact, a brood emerges during the summer about once each two weeks.

Although larvæ and pupæ of this fly may be found throughout the filter bed, they are most abundant in the zone which begins three inches below the surface and ends about twelve inches below the surface.

The abundance of larvæ and pupæ seems to be correlated with the thickness of the film. A thick film means heavy breeding, a thin film light breeding. During the winter and spring the film becomes very heavy and consequently the pest is very abundant, in the fore-part of the season. As the weather becomes warmer the filter unloads. Large quantities of the film sluff off and pass out with the effluent, and a thin film takes its place. This thin film gradually increases in thickness as the summer goes by, until in the latter part of the summer it becomes heavy and consequently develops a great abundance of flies.

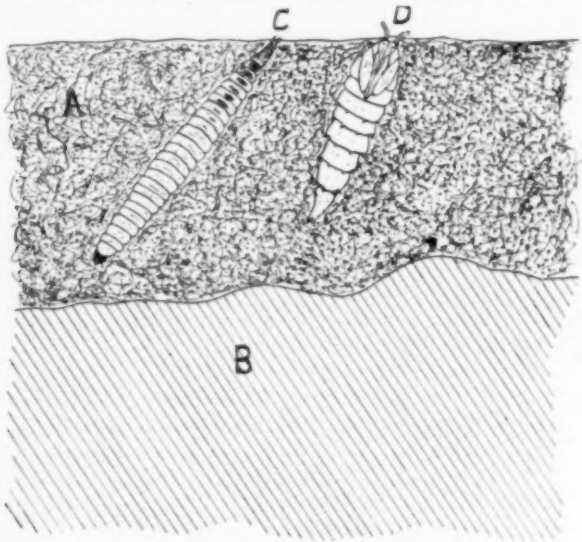


Fig. 4.—Diagram showing position of larva and pupa of the Sprinkling Sewage Filter Fly in the film. A, Film; B, Stone; C, Larva; D, Pupa.

Control

Practically all of the organisms composing the society of which the Sprinkling Sewage Filter Fly is a part, can get along without atmospheric oxygen for a longer time than it. Both the larvæ and pupæ

breathe atmospheric air. Tests made and reported[1] show that submersion of the filter bed with ordinary sewage for a period of 24 hours destroys 100 per cent of the larvæ and pupæ, leaving the film in active condition.

The first experimental submergence was made on June 14, 1918, and involved only one-fourth of the entire bed which has a surface of about two acres.

Acting upon this discovery, a bulk head pierced with a passage way which may be closed or opened at will was installed in each of the two galleries through which the effluent escaped from the filter bed of the joint sewage disposal plant of Plainfield, North Plainfield and Dunellen; a plant which serves to purify the sewage of about 40,000 people.

The factors affecting the submergence of the entire bed were tightness of the retaining walls, the volume of sewage available and the time which the bed could be submerged without injury. The retaining walls in question were composed of six-inch concrete backed by a heavy wall of soil lying at an easy angle of rest from the top of the retaining wall to the surface of the surrounding ground. This concrete wall had not been constructed to hold water, but merely to hold the stone in place and it surrounded a basin of approximately six feet deep. The normal volume of sewage ranged from $2\frac{1}{2}$ to 4 million gallons daily. The time during which the filter could be submerged and not seriously injure the activity of the film as shown by the following table was something less than 48 hours.

FLOODING EXPERIMENT CARRIED OUT IN FLOWER POTS

Length of Time Flooded	Condition of Larvæ	Condition of Film
16 hours	Alive	Alive
18 "	"	"
22 "	95 % dead	"
24 "	Dead	"
32 "	"	"
36 "	"	Slight putrefication
48 "	"	Putrefaction

The figures indicated that the filter should be filled with sewage, provided the walls did not leak seriously, within a period of 12 hours.

On August 9 the bulk head gates were shut and the water allowed to accumulate. The filter was completely under water at the end of 12 hours and was maintained in this condition for a period of 24 hours, when the bulk head gates were withdrawn and the waters allowed to escape. These escaping streams of water were full of the dead larvæ of the Sprinkling Sewage Filter Fly.

[1] Headlee, T. J., Beckwith, C. S. Sprinkling Sewage Filter Fly, JOURNAL OF ECONOMIC ENTOMOLOGY, Vol. II, No. 5, 1918.

Assuming that the nitration power of the bed is a proper index for its efficiency in sewage purification (this is the index usually so accepted by Sanitary Engineers), the following table will serve to show that the efficiency of the bed was in no wise diminished by the submergences of the season.

EFFECT ON NITRIFICATION IN PLAINFIELD FILTERS

Part Per Mill N. as Nitrate

Number of Days before Flooding							Dates	Number of Days after Flooding						
7	6	5	4	3	2	1	Flood	1	2	3	4	5	6	7
			7.0	10.0		12	6/14	11.4	Eff. of quarter flooded only					
						11	8/9	11.	10.	8.0				
			13.0	9.0		13	8/24	13.0						
		13.0					8/31				13.0			
			13.0			13	9/17						13.0	
						13	9/24	13.0	13.0				13.0	
6.1							10/14	10.0	11.0				10.0	
				6.6	6.6	6.6	10/31				6.6	6.6		6.6

This submergence was repeated on August 24, August 31, September 17, September 24, October 14 and October 31.

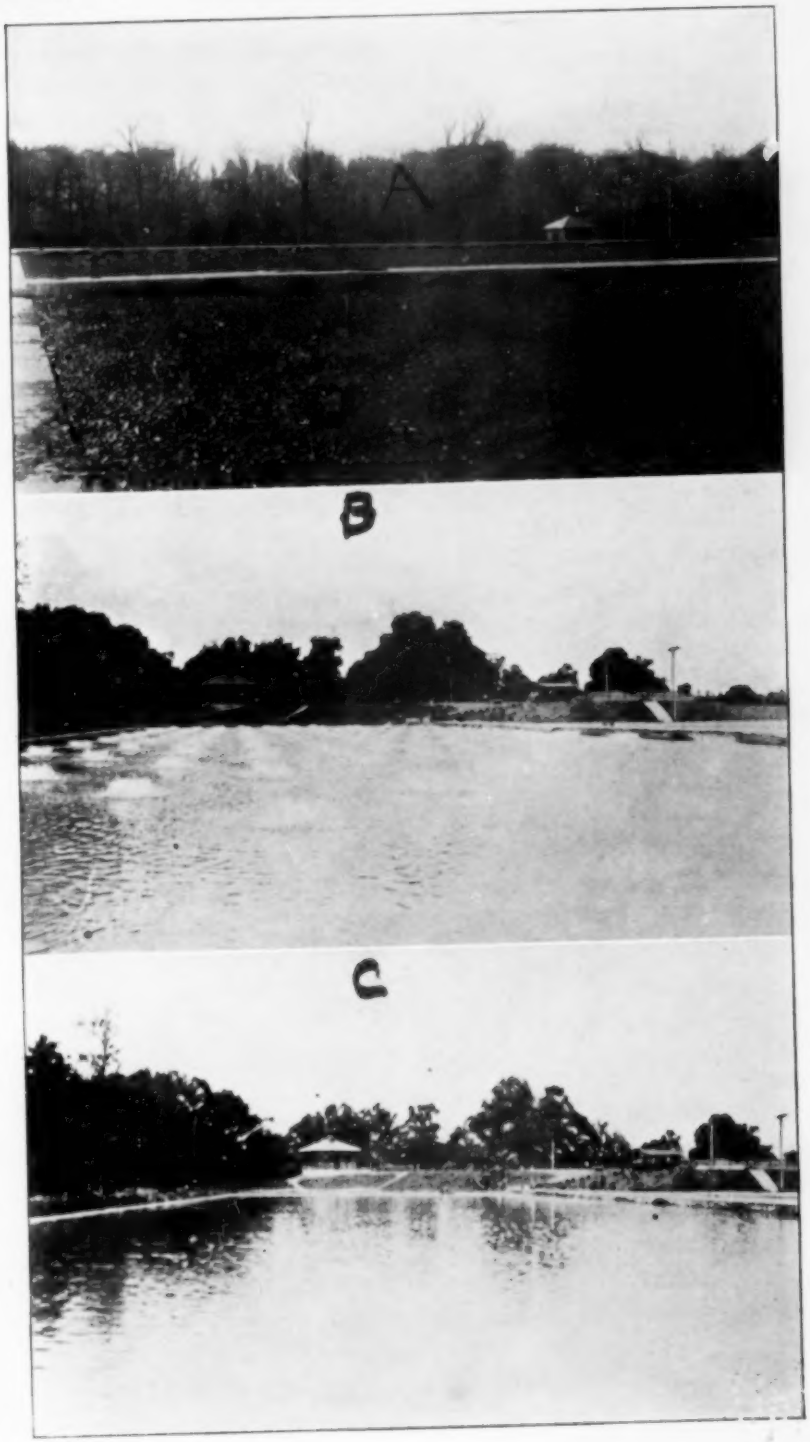
With the exception of the periods from August 24 to August 31 and September 17 to September 24, the time elapsing was two weeks or greater. The result of the practice of allowing two weeks to elapse before the submergence is repeated appears in the escape of a considerable number of flies. A repetition of the treatment at the end of one week cuts the fly pest entirely out. The two-week period gives enough time for the flies to reach the adult stage and to reinfest the filter immediately after the water is withdrawn. Furthermore, it is possible although not actually determined that the egg is able to resist the submergence.

It is unmistakeably indicated that the filter should be submerged once each 10 days until the flies are reduced. Let it be understood, however, that at no time following August 24 did the fly assume the proportion of a pest, although the interval between submergence with two exceptions was sufficient for the insect to pass through its life cycle.

The work against the fly will be opened during the coming season by submergence of the bed in the spring before the flies emerge. This submergence will be followed by treatments at 10-day intervals until the fly has been so reduced as not to require such frequency.

The greatest limiting factor in the application of this method of controling the Sprinkling Sewage Filter Fy to the various sprinkling sewage filter beds of the country is the fact that many engineers have constructed these beds without retaining walls. In such cases the writer would recommend the construction of wooden walls backed by an earthen fill or the construction of concrete retaining walls, in such a

Plate 2. General views of sprinkling filter illustrating submergence. A.—Filter inactive, note apparatus for closing and opening the bulkhead gate; B—filter approaching complete submergence, sprayers discharging; C—Filter completely submerged.


A
B
C

fashion as to permit the filling of the bed in 12 hours and the maintenance of the submergence for a period of 24 hours.

The writer wishes to take this opportunity to acknowledge his indebtedness to Dr. Leonard Haseman for identification of species, to the Joint Sewer Committee of Plainfield, Dunellen and North Plainfield for substantial aid in carrying out the experiments, to Mr. John R. Downes, superintendent of the disposal plant, for hearty coöperation in the practical work of submergence and for furnishing data on nitration, and to Mr. J. W. Thompson for making the drawings.

PRESIDENT E. D. BALL: This paper is before you for discussion.

MR. W. A. RILEY: I had the pleasure of seeing some of this work last spring and was very much interested in the fact that while it had not been established definitely that those flies were carriers of disease, we have every reason to suppose that they would be under such circumstances, and I sympathize heartily with the people who brought suit against the corporation for maintaining such a nuisance. I think that Dr. Headlee's work will be very far reaching in its applicability. For one thing, a little later I saw the filter beds and the system in use here in Baltimore, or near this city. The beds of course are enormously more extensive and the pest was just as serious here. There have been a number of suits brought against the city and decided adversely to the city here, and this certainly should be a matter of much interest to the authorities in charge of that work.

Another factor which impressed me especially in the beds here was the number of other species of flies, including the house-fly, and a number of the larger Muscids breeding in these beds. I did not see that to any such extent at the beds in New Jersey, and that was very apparent when I visited the sewer beds here. The problem for this particular locality would make a very valuable and interesting one for some one who has local opportunities to take it up.

PRESIDENT E. D. BALL: Is there any further discussion? If not, we will call for the next paper.

THE OCCURRENCE OF DROSOPHILA LARVÆ AND PUPARIA IN BOTTLED MILK

By W. A. RILEY, *St. Paul, Minn.*

(Withdrawn for publication elsewhere)

PRESIDENT E. D. BALL: The next paper on the program is, "Some Practical Phases of the Entomology of Disease, Hygiene, and Sanitation Developed by the War," by W. Dwight Pierce, Washington, D. C.

SOME NEW PHASES OF THE ENTOMOLOGY OF DISEASE, HYGIENE AND SANITATION BROUGHT ABOUT BY THE GREAT WAR

By W. Dwight Pierce

Since the great war began in Europe a branch of entomology long neglected has suddenly grown from infancy to maturity. Five years ago we had a few text books of medical entomology, and two or three universities presented courses of study in the subject. But medical or sanitary entomologists were so little known or thought of, that no place was made in any of the armies for men trained in the subject. Little by little, however, in the various armies there has been an infiltration of entomologists and it is my firm belief that the day will come when every army will have an entomological unit in its sanitary corps.

When our nation entered the war the men who were well informed on the subject of this phase of the entomological science could not have exceeded a score. But all entomologists were thinking of their part in the great struggle, and when it was announced in a three-line statement in an emergency circular that a class had been formed to study the entomology of disease, hygiene and sanitation, and that mimeographed proceedings would be sent to those who enrolled, the nation-wide interest of the entomological profession was immediately demonstrated.

The class kept on growing steadily until its enrollment exceeded 500, and many universities and colleges announced the founding of special classes in the subject. But it is not only the educational side of the subject which has grown. Hardly a day passes but that some new contribution to the science comes to hand. The technical phases of the problem are fast maturing.

Just arrived at maturity, we cannot yet prophesy the future of this branch of entomology, but it is well to see what kind of a ground work it has and what some of its new, outstanding features are. This paper is intended to serve as a setting forth of some of the basic principles of this phase of entomology.

Our science embraces the study of all the relationships of insects to the causation and carriage of disease, whether of plant or animal, because the principles are the same, and the technique is similar; the rôle of insects in materia medica; and the maintenance of hygienic and sanitary conditions for man, animals and plants, against all insects which threaten the health of these individual organisms. We touch in the various angles of the complete science many other sciences and must maintain our own entity without arousing antagonism of other sciences, but rather with a perfect accord and coöperation with them in

order that we may more quickly solve the many problems ahead of us.

In the study of disease transmission we must work directly with doctors, and parasitologists in perfect harmony. It is our rôle to understand the life-histories of the insects, their hosts and their parasites, in order that we may point out the possible manners of transmission, to assist in the transmission experiments, and to maintain the surroundings of the experimental insects such that the experiments can be successfully concluded. The doctor and the parasitologist will be just as concerned with the patient and the organism as we are with the carrier. Had such coöperation been in effect in the past, it would not be now necessary to reconduct many transmission experiments which proved failures because of faulty technique in handling the insects, or efforts to obtain transmission by bite when it should have been accomplished by some other method.

Briefly, we must summarize the methods of disease transmission by insects. The organism may be carried mechanically on the body or in the mouth parts, or may pass through the body of the insect and out with its feces. The host may be infected by the insect coming in contact with food or wounds, or by mechanical inoculation at the time of a bite, or by the insect being scratched into a wound, or by having its feces scratched in. Its feces may be dropped on food or be washed into the blood by fluids excreted by the insect at the time of feeding. The organism may require the insect as an intermediate host, and may follow many devious paths in the insect body, emerging from the region of the mouth or anus, or may never be contaminative in this manner, but require to be swallowed in its insect host by the next host in its cycle. Insects little suspected of having any rôle in disease transmission are often vital elements in the economy of a disease organism.

Since the beginning of the war the body-louse has assumed a primary importance as a carrier of some of the most dreaded diseases. Valuable studies have been made in India on the rôle of the bedbug as an intermediate host of Kala azar and kindred diseases. Further advances have been made in the study of sleeping sickness in Africa.

An outstanding feature of the louse and bedbug studies is the fact that these insects do not spread diseases by biting, but by being scratched into the flesh or having their feces scratched in. The importance of these studies must not be minimized, for quite possibly we have here a probable explanation of the means of ingress for a number of other diseases which have baffled investigators.

The part of insects in materia medica is but little known and is a field for future investigations. Certain it is, however, that insect

secretions are often very powerful and that some of those known are of very definite value.

Probably the greatest series of advances in this science have been made in the louse investigation and as a direct result of the proving that the most dreaded diseases of the armies, typhus, relapsing fever and trench fever, were louse transmitted. We will not discuss the louse problem as such but rather bring out some of the new principles which it has given entomology. Nuttall's great series of monographs on the human lice, recently published in *Parasitology*, cover the general subject very well.

There are a number of army principles more or less understood and perhaps not even set forth on paper which have actuated much of the work done on this subject. In this war everything has been handled on a scale far surpassing anything ever dreamt of before. We have had to think in millions and not in units. We have had to test each proposed method of insect control in terms of universal availability, and maximum effectiveness. Because of the immensity of the problems, scientists of many branches have contributed wonderful results to our new entomological science. We owe immeasurable credit to doctors, sanitarians, chemists, engineers, manufacturers and to the ordinary man of the street. All the brains of the nations of the world have been focused on winning the war, and one of the vital elements therein was the health of the great armies facing each other. There have been many valuable contributions from various sources on the control of the louse.

It is an army maxim that materials and methods already in use in some part of the army, and therefore more or less available, must be adapted to meet as many phases of army life as possible. New problems must be handled if possible with materials at hand. The army sanitarian must learn to shift for himself and get results without introducing too much that is new. He must be able to get results by rough and ready methods. A given unit of machinery or transportation must have its various capabilities for use tested to the utmost. The more uses a chemical has the better. Materials usually wasted in former wars are now carefully studied with the possibility of utilizing them. Waste must be reduced to a minimum. Methods, materials, mechanisms must be standardized and must be readily available. Theoretical knowledge is of little value, results count. Everything must submit to the cold proof of results. Inventive genius which can transmute ideas into practical working propositions stands high at present.

Now let us see how these principles have governed the cootie investigation and also some of our other entomological sanitary problems. We should put them to use in all our future entomological work.

The louse is an insect of filth. It is to be controlled by cleanliness, by heat, by water, by chemicals. Thus we have seen the rise of the bath trains, the mobile horse-drawn and motor-drawn bath units, the permanent bathing stations; we have seen efforts made to bathe whole nations and their armies in order to combat louse-borne diseases. To the Russians probably belong the credit for the first mobile bath units. Now they exist in many diverse types. The basic principles in the bath unit are that the men shall be bathed and their clothes sterilized and that there shall be no contact between clean and unclean garments or clean and unclean men.

The greatest problem in sterilization of the clothes is to kill all lice and vermin and all disease germs without injury to the garments, and when to sterilization can be added cleansing then we have the best process of all. The sterilization may be by dry heat, steam, hot water, gas or chemical wash according to the available supplies. Every one of the elements of sterilization has been studied more thoroughly than ever before. Steam sterilization may be accomplished in an autoclave, a room, a car, a kettle, a barrel, or a laundry washing machine; by the use of vacuum, or at normal, or increased pressure in a closed cylinder, or it may be applied as live or current steam. There is no question about the killing value of steam. In the autoclave or sterilization cylinder the complete process requires half an hour, but we have found recently that in a laundry washing machine we can kill all cooties and nits with current steam in fifteen minutes, remove the garments, shake them out and wear them. The problem in steam sterilization is one of shrinkage, and injury to the tensile strength of the fabric. Steam under pressure, even for a few minutes, is injurious to woolens. So also, is steam at ordinary pressure in a little longer time. Current steam does not shrink in fifteen minutes in the laundry wheel. Current steam disinfection of whole buildings and cars has been used and enabled the rapid handling of great quantities of garments. Detailed reports of wool shrinkage tests of many processes have been made as a result of the louse problem.

But steam, in whatever form, although effective, does not cleanse the garments.

Washing with boiling water and washing with insecticidal soaps have been often proposed and successfully used, but it remained for the Laundry Division of the Conservation and Reclamation Branch, Q. M. C., to set in action a series of investigations to determine to what extent the camp laundries could effectively control the louse. It has been the writer's good fortune to be one of the group which investigated all the laundry and dry-cleaning processes with the view of ob-

taining complete insect disinfection. We have reported[1] that the laundry processes are thoroughly efficient delousing processes and that each step in the laundry formula, washing, drying, and ironing, can of itself be so regulated as to completely kill all lice. Furthermore, if very resistant spore-bearing bacilli are suspected of being in the clothes, a live steam sterilization may precede the wash with absolutely no injury to the garments.

This primarily entomological question led to exhaustive studies of the shrinkage of woolens and the bactericidal value of each process in the laundry, and even to actual changes in laundry practice. In like manner, the dry-cleaning processes were studied and developed from each point of view. It was interesting to find that the usual 45-minute gasoline soaking in the wash wheel, and even an hour's soaking, was not effective against all eggs, but the second step in the process, the drying in the dry tumbler, completed the control.

Many people have suggested that chemicals placed on clothing would be effective repellents against the louse, and in fact there is considerable on the subject in European literature, but it was not based on scientific principles of research. This fact led to the exhaustive studies of Dr. William Moore and Dr. A. B. Hirschfelder on impregnation of garments. Then the Chemical Service started to impregnate garments against gases and finally the two efforts were welded into one. Whether we find what we are after or not, this work has already greatly enriched entomology and chemistry with a knowledge of the effectiveness of many chemicals as insecticides, the duration of their effectiveness, and their effects on clothing and skin.

The subject of insect repellents has been studied more thoroughly and scientifically than ever before. Many of the repellents and impregnation chemicals used in these tests were synthesized by Dr. Hirschfelder, and members of the Chemical Warfare Service.

The louse problem is not the only one which has yielded new phases to entomological practice. In the mosquito extermination work Lieut. E. C. Ebert of the Marine Corps, at Quantico, developed a submersible oil distributor, and also worked out many ways of spreading oil by means of oil impregnated sawdust. In the June number of the JOURNAL OF ECONOMIC ENTOMOLOGY, Freeborn and Atsatt contributed a very valuable paper on the effects of the petroleum oils on mosquito larvæ, which taken together with Dr. Moore's papers on the toxicity of vapors to insects will greatly advance our knowledge of insect control.

The fly problem in the camps led to many ingenious sanitary measures for handling garbage, manure and sewage to prevent fly breeding.

[1] National Laundry Journal, vol. 81, pp. 4–14, Jan. 1, 1919.

Dr. W. L. Mann, Post Surgeon at Quantico, has contributed numerous types of incinerators for all kinds of refuse. The disposal of waste has become more or less standardized by army practice.

An interesting feature in educational work was Dr. Mann's practical field demonstration at Quantico of models of many types of sanitary devices such as latrines, incinerators, sterilizers, steam disinfectors, etc. Certain of the army camps have installed similar exhibits. It is to be hoped that as we get settled down to recognizing sanitary entomology, there will be developed throughout the country many permanent outdoor and indoor exhibitions of sanitary and entomological devices. It is a very effective educational method.

We now come to a brief discussion of the future of this branch of entomology. In the past many times as much money has been spent for the control of insects which damage crops, as for the control of insects which affect the health of man and animals, and yet such estimates as are available show the losses to be more or less equal.

There is therefore a great field for research and practical work to be opened up and now is surely the time to begin. Well-regulated courses of study should be started in all universities where entomology is taught, and surely no medical school should be without a complete course in the entomology of disease, hygiene and sanitation.

Each year we learn of some well-known disease being connected more or less intimately with insects. We must therefore settle down to a careful and systematic study of how insects can be concerned in the transmission of the diseases prevalent among us. This work will involve careful biological studies of all suspected species to equip us thoroughly with a knowledge of their habits and methods of control. Fortunately there is a great mass of material already accumulated, which must, however, be digested.

Many of these biological and practical studies must be worked out from the standpoint of municipal conditions, factory and commercial practices, rural customs and popular prejudices.

Then there must be careful studies in many places of the usual and occasional fauna of parasitic insects, and also of their capability of taking up and transmitting disease organisms.

Finally the time will arrive when there will be undertaken long series of careful transmission experiments in which the best coöperation of parasitologist, entomologist and physician or veterinarian will be imperative.

We are now beginning a period of reconstruction in our national life. Educational and investigational work of all kinds must be overhauled and developed to meet the spirit of a new time. Let us in entomology not be found backward in adjusting our science to new requirements.

MR. W. D. PIERCE: The laundry report in full, which is a co-operative report with the Quartermaster's Department, will be published in January. I do not know that it will be printed in any of the Entomological Journals. It gives an entirely new phase to Sanitary Entomology; that is, its application to industry. We have just found that by lowering the specific gravity of the oil used in dry cleaning establishments we can bring about control.

MR. E. H. GIBSON: I have been in charge of the insect work in one of our largest cantonments during the past nine months and wish to take this opportunity to express my appreciation of the excellent work and the interest taken by Dr. Pierce in activities along the line of insects in relation to health and for the class which he has conducted in Entomology.

MR. W. A. RILEY: In this connection, I feel compelled to say that it is unfortunate that many of these reports that have been made during the past few months are not going to be more widely available. At the outbreak of the war, Mr. Moore, of Minnesota, was asked to take up this line of work, and with thorough generosity, the authorities there gave him all of his time and all facilities for doing this work. He has published a few brief papers, and one of the very important ones which is about to appear is one showing that apart from disease transmission, the louse problem is of more interest to the medical man than has been supposed, that gross infection of lice is an actual cause of persistent fever, and in one case, one of those experimented on, it showed very serious results. We feel confident that if the man had been subjected much longer to the experiment, it might have resulted even fatally.

In other words, that without any disease transmission at all, the bite of the louse itself was a serious thing, when it came to gross infection, and we have since had a paper from a medical man who observed a similar case in San Francisco and who did not interpret it until he received these results. These reports of Mr. Moore's, of course, have been made constantly to the Bureau and to the authorities in Washington, but unfortunately they have not been published in any extended manner.

MR. W. D. PIERCE: It might interest the association to know that a complete bulletin will be prepared by the Bureau of Entomology on the louse problem.

MR. W. C. O'KANE: Dr. Riley, in speaking of fever being caused by the bites of lice, I personally have had the experience of a pretty high temperature brought on by too many jiggers in South America, several hundred I imagine, followed by a fever lasting some days, etc.

MR. W. A. RILEY: It is a peculiar fact that this condition has

not been noted by any of the modern workers on the louse problem. There were a few references many years ago, in which there was some mention of fever in connection with lice bites, but there was no significance attached to it.

VICE-PRESIDENT W. C. O'KANE presiding.

MR. W. C. O'KANE: We will now take up the discussion of the presidential address.

MR. T. J. HEADLEE: I have been much impressed with the address of our president. He is advocating fundamental training along biological lines for persons who would enter the field of economic entomology. In this he does not apparently agree with many of the addresses and discussions hitherto presented to this association dealing with the problem of training economic entomologists. The attitude taken in many previous papers on this subject has been that the man prepared for economic entomology should be thoroughly trained in agriculture and in the direct technical side of his profession, the idea apparently being that unless he is familiar to a great extent with economic insects he is not in a position to measure up with men in other lines of scientific agriculture. As I see it, this is only a part of the movement in scientific agriculture which has taken place during the last ten years, the object and aim of which has been to produce men trained in the technical side of the science, without much regard to their preparation in fundamental science and the humanities.

It seems to me that this address of our president marks the swing in the opposite direction. I may say at once that I am in entire sympathy with this change of front.

In a few instances in the past ten years addresses have been delivered advocating training of a similar sort, but the bulk of teaching opinion has seemed to be on the other side.

From the beginning of economic entomology until the present and probably to a distant date in the future, the tendency to study the life history of economic insects, without regard to the nature of the environment in which they live, has been and will continue to be very paramount.

Professor Sanderson in his address as president of this association at Minneapolis some years ago advocated the idea of studying the economic insect not only from the standpoint of life history but also from the standpoint of its ecological relations and suggested that a standing committee on entomological research be authorized, the purpose of which should be to hold up ideals of economic entomological research. With the passage of time the activity of this committee became limited to the preparation of a list of the projects on which the members of the association are engaged. This, according to my view, is a mistaken

tendency and prevents the said committee from doing the very work for which it was originally appointed.

MR. W. E. BRITTON: I think that excellent ideas have been brought out in the president's address and I agree with the remarks of the speaker who has just commented on it.

We have had a great many papers and a great deal of emphasis has been placed upon the necessity of having been trained in an agricultural college. So far as I can see, the chief reason for this has been, that men shall get the right viewpoint, that is a sympathetic one, with problems of agriculture. As you know, many of our colleges and universities have not especially induced students to take hold of economic problems. That is true not only in entomology, but in all other subjects. There has been a tendency to encourage work in pure science.

Now at the present time the pendulum has swung in the other direction; because of the necessities of war we have been obliged to solve many economic problems, such as problems of food production, ammunition making, poisonous gas-making, etc. So that for the past year or so nearly all of our efforts have been directed towards work which will be beneficial to us as a nation, or to mankind.

The present is an especially favorable time to begin efforts towards the solving of other problems which have a bearing on economic lines. So if we can use the two together, that is, have the broad foundation, and then direct efforts with the spirit which we now all possess, it seems to me that we may be able to get the greatest degree of efficiency in entomological research.

MR. E. P. FELT: I want to express my appreciation of the president's address. It seems to me that he has touched some vitally important matters, and at a time when they could be discussed to particular advantage. As stated by the various speakers, we have been obliged to coöperate in order to win the war. We are learning what the other man can and is doing, and the proposition that I would like to emphasize in this connection is this: Is there any way in which these suggestions can be crystallized into something practical in the way of closer coöperation between entomologists throughout the country. Of course we are all independent, we do not like dictation, but if we can recognize that each, within certain limits, is a specialist along one or more lines, and work out some means whereby there will be effective coöperation, not only in entomology but associated sciences, we might bring about something of great value for the future. The difficulty has been to get a workable plan.

MR. Z. P. METCALF: It was not my good fortune to hear the presidential address, but there is one thought that might be worth

while for the members of the association. A few years ago Professor Herrick made the text of his presidential address that the worst weed in corn might be corn and the worst thing in a course in entomology might be too much entomology. The entomologist needs a broad foundation. I doubt very much if there are many other fields where a broader foundation is needed. This foundation should be laid in biology. At the present time there is too much emphasis on the more technical phases of agriculture and not enough upon the broad general principles of biology.

SECRETARY A. F. BURGESS: It seems to me that we are all agreed that the entomologists should have a broad, liberal training as a foundation. After that has been secured, specialization is not only necessary but very desirable. In the field of entomology we find the activities greatly specialized. As time goes on entomology will become more and more specialized. The man who becomes expert in a special line of investigation must follow that line to the exclusion of other special activities. Dr. Ball brought out the fact that the San José scale had been responsible for the enactment of many of the state laws relating to insect control. Inspection work requires some things in which many entomologists have not been trained. A good inspector ought to have a short course in business administration.

MR. T. J. HEADLEE: Doesn't he get it?

SECRETARY A. F. BURGESS: He undoubtedly gets it by hard knocks but he gets it not only at his own expense but at the expense of the people that he is attempting to serve. There is another point brought out by the address of Dr. Ball relative to conditions in the future, and that is that our leaders or leader should be a man with broad vision.

I believe that is absolutely correct. The practical side of the problem, however, cannot be ignored. No matter how much vision a man may have, if he is tied down with a thousand and one duties which he has to perform in order to earn his daily bread, he does not have the time to work out and put in force ideas that may come to him and which would be of benefit to us all. It may help but it does not secure the goal for which you are striving unless it is somebody's business who has time to attend to that business to put the ideas into operation.

MR. W. D. PIERCE: Mr. President, Dr. Ball brought up some points in his address that have interested me very much. He brought before us visions of some of the big fields that entomology is to come to in the future; for instance, the extermination of the boll-weevil in the south, by the temporary suspension of cotton growing. This question has been considered a great many times. I don't doubt but that Dr. Ball is prophesying something that will take place some

time in the future. But before we come to anything like attempting those great big-scale tests, we have got to have entomology better organized, we have got to have our men trained up to handle things in big ways and handle them coöperatively. A task like that would mean an organization with millions of dollars to be used. I believe it is possible, just as Dr. Ball does, that some day the boll-weevil will be pushed back, and that we will push back many other pests out of our nation by coöperative work, just as the cattle tick has been almost pushed out of this country simply through organized effort.

Now we have almost pushed the pink bollworm out in the operations of this past year. I think we are going to come to the time when we will do bigger tasks, but we must get on the broad basis of coöperation and we must know our principles, we have got to be trained more broadly than in the past.

I want to make one correction to Dr. Ball's address, and that is regarding his statement that the boll-weevil has only one food plant. It has one other, a native wild plant which grows in the mountains from Guatemala to Arizona. We have found some of the native plants and woodlands of the south can to a limited extent serve as hosts for it, so that even if we did suspend cotton growing, we might find it in some of those other plants.

MR. E. D. SANDERSON: Mr. Chairman, as I have not had the pleasure of meeting with this association for some time and as I will not be able to stay through the session, I want to now express my appreciation of the president's address, because it is along lines which have always appealed to me.

The matter of training is one to which more attention may well be given. At various sessions we have considered courses for graduate work and study. It seems to me the association might give more serious thought to graduate training in entomology, possibly through a committee. I think the graduate training in the technical branches of agriculture is one of the weak points of agricultural education. More and more men are going, not to agricultural institutions, but to some of our leading universities for graduate work in the pure sciences, and I feel that the agricultural institutions have not had a large enough vision of the training necessary in graduate work. There has been too much tendency to look at the technical aspects of the subject and not enough to fundamentals.

It was my good fortune a couple of years ago to have a course on the logic or method of science—rather an abstract thing many of you will think—but I received more from that course than almost any other course I have had. I had been working in science for some years and I thought I knew something about science, but I had never given the

matter serious thought of what was the method of science. In talking with a good many men and experienced scientific workers, I have come to the conclusion that if a great many of us had that foundation point of view which we get by considering the logic of science, it would be worth a great deal to us. I think every student ought to have some training along that line.

There is another matter on which I want to touch briefly, that is this matter for organization in putting over some of these big entomological undertakings. The boll-weevil has been referred to and that is a matter which has always interested me, because I was actively engaged in combating it some years ago.

The start, in a way, of the big extension movement in agriculture, which we have today, was from Dr. S. A. Knapp's work in Texas, in trying to fight the boll-weevil. He didn't know anything technically about the boll-weevil, but he was a mighty canny student of human nature and he demonstrated a method of fighting the boll-weevil which developed into the demonstration method that has gone on, until we have our present agricultural extension system. I don't mean to say that was the only basis of our present extension work but it was one of the largest factors in it. Now then, why didn't we as entomologists do that? Why didn't we show the people of the South how to fight the boll-weevil and why was it that we didn't get one job across instead of letting some other people do it for us? I have often thought of that.

I simply cite that because it has been mentioned and it is such an historic instance. The point is that today, as has been pointed out, the science is getting so large that there must be specialization. It is perfectly useless, in my humble judgment, to put a man who is a natural research man and who has been trained for minute laboratory research in charge of a big extension job. Occasionally you get a genius who can do anything, but most men aren't built that way.

Most men are better at some particular line, research, extension, or teaching. And it seems to me that that must be recognized, and that in any of these big undertakings we must make a study of the human nature factor and we must put the man in charge of that line of work who is willing to devote himself to that sort of thing. He may be a relatively mediocre research man, but if he is associated with a research man and he knows how to take the results of research to the people and "get them over," as we say, he is as valuable to science as the other man, because after all no piece of investigation is done until it is actually put into practical operation. An experiment or a demonstration is never done until the people actually use it, and if it isn't worth using the investigation, in so far, is incomplete, because it has not produced practical results in use. So I think there must be greater division of labor, which, of course, is coming about very rapidly.

MR. H. A. GOSSARD: Mr. Sanderson has very nearly said one or two things that I thought I would like to say. The visions that Dr. Ball holds up have always been a very attractive sort of thing to the entomologist and it looks as if we ought to be able to do some of the things that he suggests. We will be able to do them by and by, but there are some things we must learn to do, in coöperation with people who are not entomologists at all, before there is any hope of accomplishing such things. We cannot, for instance, exterminate the boll-weevil, and there are a great many other things that we are failing to do—because for some reason, good or bad, we have not secured the coöperation of the powers that be, to the extent that we can do justice to large sections of people and to the individuals composing such sections and at the same time accomplish our projects. Until we reach that point where we can do justice to the cotton grower who is deprived of his privilege of growing cotton, not alone do justice to the cotton section, but to the individuals in it, there isn't much hope of putting a thing of that kind across. In other words we must coöperate with economic workers, sociological workers and perhaps with constitutional lawyers. Anyhow we must do a coöperating "stunt."

Now there is no use talking about an entomologist getting an education that will fit him to draft the laws, etc.,—he may not be even able to organize a system to carry these into effect, but he will have to learn to coöperate with the people who can before there is any reasonable hope of accomplishing these things, and whenever we do coöperate fairly, there is a reasonable and a practical basis for such a hope.

CAPT. E. H. GIBSON: Mr. Chairman, it has been my pleasure to attend a number of these meetings and to hear various very admirable presidential papers. No doubt there have been results come from each one of these but I contend that we have not had enough positive, direct results.

Now, Dr. Ball has given us many suggestions, and the remarks that have followed by Dr. Headlee, Dr. Felt and others, all tend to the right direction. Let me suggest, if I may, that this association have a committee which might be termed an entomological training coöperative committee, if for nothing more than to offer its services to the various colleges and universities throughout the country, for the purpose of bettering the fundamental training of the entomologist.

I would lay this suggestion before the older members of the association, men who have had more experience in the profession than I have, to make a motion to this effect, if they see fit. I think the time is ripe to do that. It may not be well to have this committee formed immediately, but I believe a definite step should be taken to carry out the suggestion that Dr. Ball and the other members have made this

afternoon, regarding the betterment of the training for future entomologists.

MR. T. J. HEADLEE: I move that a committee of ten men be appointed as a standing committee on entomological policy; two men to retire each year and be replaced by two others.

The duty of this committee will be the consideration of the various problems that have been raised. We have a committee on agricultural policy in teaching, and research, and these committees met a long-felt need. We are a national organization and are supposed to be leaders in entomological thought. Such a committee could serve the association and be a body from which suggestions would come and be put into operation as they are authorized by the association.

The motion was seconded by Mr. G. A. Dean.

MR. W. J. SCHOENE: I would like to suggest that the president be a member of this committee so that the suggestions which he may have can be acted upon by the committee.

MR. G. A. DEAN: Dr. Ball has presented to this association a paper that I have wanted some one to present for the last four or five years. I wanted it to come from a man who not only has had fundamental training in science, but who has also had many years' experience in the different branches of entomological work, such as the experiment station, the college or university, the extension and the regulatory. I have listened with great interest to the discussions from men who are experiment station entomologists, extension entomologists, state entomologists, entomologists in charge of teaching in colleges and universities, and entomologists in charge of regulatory work, because in the institution with which I am connected, the head of the Department of Entomology is in charge of all these different lines of entomological work. I seconded the motion because I feel very keenly that a committee of this sort could bring about or formulate a plan that would be of much help, not only to those entomologists who are in charge of one particular line of work, but also to those of us who are in charge of the various lines. I do not believe we can overemphasize the importance that Dr. Ball has laid upon the fundamental training of men for entomological work.

There are men in this meeting who were in my classes at the time when only a few courses were offered in entomology. They have done some excellent work. Again, there are men here who received training along some particular line, but were compelled to do entomological work along another line. They, too, have made good entomologists. Why have these men succeeded? In my mind, simply because they were able to get strong courses in other departments, and with this fundamental training, together with good minds, were able to do

research work. One of the best teachers I ever had in entomology did his major work in zoölogy. This simply emphasizes the points brought out by Dr. Sanderson, that you cannot expect a man who has had special training along just one particular line to succeed in others unless he has had first the fundamental training in science.

If a man has had deep and fundamental training, and has the brains and capacity to do research work, I don't care whether he had twice as much zoölogy, chemistry, or physics than he had of entomology, he will make a valuable man in entomology, providing, as I said before, he has the proper stuff in him to make an entomologist.

There are men here, who, when they were students in my department, complained because they were urged and even compelled to take more chemistry, physics, plant pathology, agriculture and German, because they felt that they were not getting enough entomology. I am sure that these same men now feel that these subjects have contributed much to their success.

President Ball resumes the chair.

MR. W. C. O'KANE: This whole subject is one that is vitally important to every man here. We have listened to a splendid address by Dr. Ball, and in past years to other helpful addresses that bore somewhat on the same subject, including those by Sanderson and by Herrick. But we haven't yet carried the thing through to that which is concrete. If Dr. Headlee's plan of a committee of ten can materialize into something substantial, it will be a real step forward.

We have spoken of the need of more fundamental, broad training for entomologists, and at the same time we urge specialization. These two things may seem to be incompatible. But are they? Do they not go together? In other words, should a man not have a broad foundation to start with and should he not then specialize in the particular line to which he is adapted? I wish that entomological training might be on the same basis as that of doctors; that a man might have four years of broad collegiate study and then have three or four years of specialized training after that. You can't put both of those things into four years of college. That is our fundamental difficulty in entomology, just as it is in various other professions.

In our investigational work we need to seek more of the coöperative help of investigators in other lines.

There are very few of the big problems today in entomology that do not include phases of chemistry or meteorology or physics or botany. The specialists in those lines should share in the inquiry. Take the problems that Dr. Ball has mentioned here. Practically every one of them should be undertaken as a coöperative project, with competent specialists working with the entomologist.

Vice-President O'Kane take the chair.

PRESIDENT D. E. BALL: I believe that Dr. Headlee's plan is better than the one I offered. A committee with each member serving five years will give opportunity for the maturing of a policy and its adoption by the association; and still leave time enough for carrying it into effect by the men who had the vision to plan it.

The present executive committee made up of the officers of the society changes practically its entire membership each year. It is impossible for a group of men to take up fundamental problems and accomplish anything in a single year.

The executive committee of the American Association of Agricultural Colleges and Experiment Stations is a practically permanent committee with a permanent chairman. The valuable work accomplished by that committee in obtaining support for work in agriculture, as well as coördinating and strengthening the agencies engaged in its development, is a striking example of the efficiency of that type of an organization.

This committee of ten can be organized into smaller committees to take up different lines of policy. A sub-committee might, for example, take up the standardization of courses of study for the training of entomologists. A statement of the fundamental requirements of such a course endorsed by this association would be very helpful to those of us trying to establish the right sort of training in our respective institutions. Such a committee could take up the problems of research, of publication, or any other factor of importance to our science. No such results can be secured from our present type of organization. I looked over the situation at the beginning of the year and did not consider it worth while to attempt anything. We are coming to a point where we must have a strong organization and now is the time to start the movement.

One of our sister societies is already putting an international organization in the field. The Economic Entomologists have done more to internationalize their science, than any other organization. Would it not be a good idea for this meeting to formulate a plan for an inter-allied federation of entomological workers?

In conclusion, I wish to urge strongly the adoption of Dr. Headlee's motion. Let us have a practically permanent committee on Entomological Policy.

MR. E. P. FELT: I believe there is a field for this sort of a committee. I have a feeling, however, that if we are going to have a strong organization, that eventually it should not be as a special committee on policy, but it should be an executive committee, with a term of years in office. The defect as Dr. Ball has pointed out is this: That the officers responsible for the conduct of the association are

mostly annual. I would like to see a committee appointed with a fairly permanent tenure of office, to take up this matter now, and also go a little bit further and see an amendment to the constitution which would result in remodeling our Executive Committee and at least have a majority—perhaps of this committee—swung over into the Executive Committee by due process and be responsible for the general policy of the association.

MR. Z. P. METCALF: I move that the motion be laid upon the table until the business session. We have several conflicting views and as this is a very important matter, I think it ought to be considered thoroughly before action is taken. The suggestion, I believe, is a good one, but better results will be secured if careful consideration is given before the motion is adopted.

By vote of the association, the motion was laid on the table until the business session. Final action on this matter will be found in Part I of this report.

President E. D. Ball resumed the chair.

PRESIDENT E. D. BALL: The next paper will be by H. A. Gossard, entitled, "The Ohio Wheat Survey."

THE OHIO WHEAT SURVEY

By H. A. GOSSARD, *Wooster, Ohio*, and T. H. PARKS, *Columbus, Ohio*

For two seasons Ohio farmers have had the results of a state-wide survey of wheat enemies to guide them in deciding if wheat growing would likely be a safe agricultural project and when the seeding could most advantageously be made. The plan of operation, the cost of the work and the results obtained may be items of considerable interest to the wheat-producing states, while states largely engaged in the production of any important agricultural staple or staples will doubtless find material of interest in this review.

GENERAL PLAN OF THE SURVEY

The survey of 1917 was organized and directed by the senior author, that of 1918 by the authors conjointly. Back of both surveys was the cordial endorsement and help of the entomological departments of the State University and of the State Department of Agriculture, without which aid it would have been practically impossible to carry the project to success. Field surveyors were drawn from all these departments and all had a share in financing the last survey though the first was financed wholly by the Experiment Station.

The idea behind the survey has been not to make it deal exclusively with wheat insects, but to gather at the same time as much knowledge

as possible regarding other pests. We timed the work just before the wheat harvest so as to insure, if possible, results of value sufficient to justify the expenditures made, and hoped at the same time to gather information regarding other pests sufficient to give us a comprehensive entomological perspective of the entire state. Definite knowledge of the kind sought is useful at all times, especially so in war time. Entomological surveyors competent to do the work and in sufficient numbers to accomplish it have only been available in Ohio at the close of the spring semester at the University when a number of advanced students in entomology become available and are glad to obtain a summer's experience in field practice. We give the young men a course of reading and have them examine specimens in our collection and do some work in the wheat plots on the Station farm and in fields near Wooster before sending them out. Also we plan to have them work for a few days with experienced entomologists before sending them to do independent work.

In 1917 we commenced at four points along the southern border of the state a short time before harvest and four lines were run from these points more or less parallel with each other to the northern border of the state. Only one of these lines was surveyed entirely by automobile, the other three being selected with reference to easy railway connections from south to north.

No matter which plan was used, each surveyor was instructed to spend about one day in each county assigned to him. Although his route was mapped, he was given some latitude in going a county or two to the east or west of the indicated route in case entomological discoveries or reports indicated to his judgment that this was desirable. The stopping places selected were generally county seat towns in which were the offices of county agricultural agents. These agents were advised beforehand by letter of the survey being made and their willingness to coöperate in the work proved a great help not only in directing the surveyors to the most important wheat districts of their counties but in keeping down the expense to the state, for many of these agents placed themselves and their automobiles at the disposal of the surveyors, thereby shifting part of the cost to the counties.

In 1918 we arranged to do as much of the work by automobile as possible since we had found this to be the cheapest and most efficient method of doing the work. Only two men used the railroad plan this season and their territory was restricted to a small number of counties. Either automobiles or livery teams were employed by these two men to carry them from field to field.

In both surveys, from ten to twenty-five fields, or a few more or less, were taken to represent the county and these were located on as long

a circuit as it was possible to cover in a day. The practice of the surveyors in getting the records varied according to circumstances. In western Ohio where the jointworm was prevalent and Hessian fly more numerous than in other sections, accurate counts of infestation were made from every field investigated in both seasons. In 1917 an indefinite number of straws from each field was taken and the percentage of infestation calculated. The samples would range from a few less than 100 to considerably more than 100 straws. In the same territory, during the survey of 1918, exactly 100 straws were counted and pulled from each field and one man made the count seated in the back of the machine while another drove from five to ten miles before making another stop. About eighty miles per day were averaged for each county and about ten fields in each were examined. Counts were made for both Hessian fly and jointworm.

In the northeastern part of the state where there was less of Hessian fly and a different species of jointworm, *Isosoma vaginicolum*, a somewhat different plan was followed. Here each surveyor was usually working alone and therefore could make no examination while driving from one field to another. Counts for jointworm were made in most of the counties, but this was not so necessary as with *Isosoma tritici*, because most of the infested straws are discernible from a short distance, and a practiced surveyor can estimate with approximate correctness the percentage of infestation within a radius of six or eight feet around the point where he is standing. Also when repeated examinations discover only an occasional flaxseed of Hessian fly, which counting reduces to less than 3 per cent, the surveyor is apt to feel that he can get a more accurate knowledge of the county he is working by quickening his pace and examining in total a much larger sample than 100 straws from each field. He can then visit twenty or more fields in the county during the day, making an approximate estimate of the percentage of infestation and occasionally checking his estimates with an actual count. The chief defect with this method lies in the fact that the indefinite results do not furnish a good basis for comparing conditions from one year to another and the gradual upgrade of an incipient outbreak would be less easy to detect than if there was a definite record of actual counts from every county through a series of years. Whether 100 straws from ten to fifteen fields strung over a county really furnish a substantial foundation for a significant record we cannot yet tell, but Mr. Houser who has worked the western area both seasons and has had extended experience with both *Isosoma tritici* and Hessian fly thinks the records, meager as they admittedly are, really possess a dependable significance and will become increasingly valuable if the survey is continued through a series of years. Con-

siderable attention was given to the wheat midge the past season as it was widely distributed, but we found no definite method for recording the exact degree of infestation. Other insects were made the subjects of inquiry as indicated on the daily report blank used by the surveyors and exhibited herewith. Also a blank report was filled out for each wheat field visited (blanks attached).

Cost of the Survey in 1917

In 1917 one of the surveyors spent eleven days in the field using an automobile exclusively for all travel. He succeeded in hiring a Ford at $4.50 per day for this use, making the automobile cost $47.25 and the cost of his maintenance for the period was $22.40. His total expenses in surveying sixteen counties was $69.65, or a little more than $4 per county.

The other three surveyors traveled by rail from county to county and either hired automobiles or livery teams for the actual field work or else were taken in charge by the county agents who arranged for transportation.

One of the three surveyed eleven counties at a cost to the Station of $77.25. To this should be added the transportation costs borne by the counties and of which we have no record. They probably amounted to $50.

A second surveyed twelve counties at a cost of $111.68. Again to this should be added an estimated item of $50 which was borne by the counties.

The third man working by rail covered thirteen counties at a cost of $104.55. We estimate that $60 should be added to this amount as the item borne by the counties. A few counties such as Wayne, in which the Experiment Station is located, were surveyed incidentally without cost to the state other than the time of the entomologists which was covered by their regular salaries.

The total cost to the state and counties of the survey made in 1917, exclusive of the salaries of the surveyors, was $463 as closely as we can determine. Allowing three weeks as the average time worked by each surveyor, the total cost, salaries included, was $1,048 as nearly as can be determined. This figure includes the salary of the Director of the Survey as well as of the field men, though most of the Director's time was given to other matters than the survey while it was proceeding. Out of our eighty-eight counties, fifty-six were entered and we obtained rather meager but first-hand information as to conditions within them. The counties not entered were, many of them, between the parallel lines of survey, and others were not important wheat-producing counties. We obtained such information from them as could be

gleaned from questionnaire blanks sent to the county agents or county food commissioners in case there were no agents.

Results of the Survey of 1917

Was this expenditure worth while? Part of the answer can be found in the results with the potato aphid. Mr. Houser ran into the worst area of infestation in the first county on his route, and arrangements were at once made for stationing a man in this field for detailed study of the species. Bulletin 317 of the Ohio Station by Messrs. Houser, Guyton and Lowry, review the results of this effort. County Agent Van Atta reported that spraying demonstrations were conducted with growers whose total plantings aggregated 308,000 plants. By very conservative estimates over 30,000 bushels of tomatoes worth $1 per bushel were saved to this county by proper spraying. Since the College of Agriculture and the Kentucky Tobacco Product Company each had a representative also assisting the county agent we evidently can claim only part of the credit for this saving; but we need to claim only one-thirtieth part of it to find payment for the entire state survey and I am very sure none of the workers participating in the aphis fight would put our part in the total result at so low a fraction. As an after result, the publication of this bulletin made possible an intelligent fight against the pest during the season of 1918 and in all likelihood $50,000 is a small estimate of the values conserved the past summer as the direct result of its publication.

Because we were able to assure our farmers that there were no large areas overrun with Hessian fly and were able to locate the joint worm areas, the survey contributed a good deal toward increasing the wheat acreage in the fall of 1917. The State Department of Agriculture reported an increase of 10 per cent in acreage and part of this must be ascribed to the fact that our farmers were not fearful of the results if they seeded a few days earlier than usual and were therefore able to use their time to greatest advantage, an important matter when the labor supply on the farms was very short.

Cost of the Survey in 1918

In 1918 the work was more thoroughly done than in the preceding year. We entered and explored with some care, as previously described, seventy-three of our eighty-eight counties. The omitted ones were not important wheat-producing counties and were rather difficult of access. One of our surveyors spent twenty-four days in the work, traveled 1,894 miles, surveyed twenty-four counties and expended for machine hire and maintenance $168.36. An assistant who accompanied him and also surveyed a route of his own, including five

counties, expended $80.41. A third man who had the longest and roughest route of any spent twenty-seven or twenty-eight days in the work, looked over twenty-five counties, and spent $175. Six other men participated in the work, in some cases spending only a day or two in their home counties, in other cases surveying five or six counties; but in these cases each county was a separate undertaking and disconnected with any other trip.

The total cost of the survey of 1918, exclusive of salaries, was $578.45. With the salaries and wages of all the workers included the cost was approximately $1200. These expenses were born coöperatively by the Experiment Station, State University and the State Department of Agriculture.

Results of the Survey of 1918

It is yet too early to fairly appraise the value of the past season's work. Near the conclusion of the survey, potato aphis was encountered in damaging numbers in northern Ohio and spraying demonstrations conducted as in the previous year. Investigations later made by the Extension Entomologist over ten widely separated counties revealed the presence of 65 to 80 per cent parasitism among *Isosoma tritici*. The location of areas inhabited by chinch bugs has enabled the Extension Entomologist to concentrate attention upon this insect, while information about other insects collected by these trained entomologists has been of much value in forcasting extension problems which can be better dealt with in their incipiency. That we were again able to allay the fears of our wheat growers regarding any disastrous menace to the 1919 crop is part of the explanation for the increased acreage put out the past fall, notwithstanding the shortest labor supply we have experienced in many years. We were able to definitely encourage increased plantings in northeastern Ohio and hold out the hope of a reduced infestation from jointworm everywhere in 1919. The location of the areas inhabited by chinch bugs has enabled our Extension Entomologist to concentrate attention on these districts. We were again able to shoo away the Hessian fly bugaboo sufficiently from more than half of the state to enable the farmers to take advantage of all their available time. We will doubtless find some neighborhoods and sizable districts outside the territory where we counseled caution that will produce too much fly because farmers hurried their seeding a little too much, but we cannot now see any state-wide threat to our next crop and believe the total harvest in bushels next summer will be much greater than if we had held all our growers back because of lack of definite knowledge.

Possible Results from a Series of Annual Surveys

The immediate object of the two surveys completed was to obtain definite knowledge regarding the distribution of wheat pests, especially jointworm and Hessian fly so we could furnish reliable and immediate advice to our farmers as to the risks they were taking in the various quarters of the state if they seeded wheat and to tell them how to minimize the damage. The date for seeding, also cultural and fertilizer practice were recommended on the basis of our findings. This information was disseminated by letters to all the county agricultural agents, through press bulletins, by special articles in the agricultural papers and through special reports printed in the September monthly bulletins of the Agricultural Experiment Station which reach about 50,000 farmers.

Results with other insects, such as the Potato aphid, were given out somewhat differently but knowledge gathered about them should be considered an immediate result of the survey.

But large-scale and long-term observations of this kind can possibly throw some light on such questions as these: What percentage of infestation constitutes a Hessian fly menace? Can a severe outbreak of Hessian fly approach undetected in a state where such surveys are made annually? Is a 3 per cent infestation a menace sometimes when a 20 per cent infestation is not at other times? Do weather conditions or parasitic "wheels within wheels" determine the increase? Is the menace greatest from nearby localities with ordinary infestation or from great areas of highly infested stubble at a long distance away? If extensive migration occurs, does the fly-free date, fixed for a given point by experimental sowings or by the law of latitude, altitude, etc., remain effective for this point, with a badly infested large area fifty or seventy-five miles to the south? If the data we are securing are too meager to answer such questions, how much more do we need, and of what sort, in order to obtain the answers desired?

Mr. T. J. Headlee: There are two questions that I would like to ask the speaker. Does the pink and green aphis of the potato and tomato appear on these plants in small numbers, then gradually by normal increase, create the serious infestation, and is it possible to find a time before the plants assume a recumbent habit of growth when the lice may be destroyed by ordinary potato and tomato spraying machinery? Did the speaker attempt to destroy these lice by spraying?

Mr. H. A. Gossard: I will ask Mr. Houser to answer that.

Mr. J. S. Houser: We can detect an outbreak of the pink and green potato aphid at an early stage and particularly during the earlier

part of the season. In other words, an outbreak seems to be a development from small, initial colonies which gradually accumulate a momentum which we finally term a scourge. Later in the season, there is some reason to believe that migrating swarms suddenly appear and heavily infest an area within a brief time. On potato, the topmost leaves are affected first and at the outset do not curl. On tomato the infestation is sometimes carried from the seedbed, but in most instances the plants become infested after they are set in the field. We have told our growers that when plants six to eight inches high bear 20 to 40 aphids it was time to spray.

The scourge usually starts first in southern Ohio and gradually works northward, there being about a month's difference in the time the insect is seen in the southern sections and its appearance along the lake shore.

As to the treatment: we have found nicotine sulphate used at the rate of $\frac{3}{4}$ pint to 50 gallons of water with enough soap added to form a good suds to give good results. The amount of soap varies with the hardness of the water, but on the average two pounds of hard laundry soap is adequate. A power sprayer is used with three large disk nozzles to each row, one spraying directly downward and one on each side of the row set at an angle to spray upward in order to reach the insects upon the underside of the leaves. Such an apparatus is useful only so long as the potatoes or tomatoes are standing upright.

MR. T. J. HEADLEE: What pressure do you use?

MR. J. S. HOUSER: We used from 125 to 175 pounds per square inch.

MR. H. A. GOSSARD: How many applications?

MR. J. S. HOUSER: It sometimes takes three sprayings to subdue a scourge.

MR. T. J. HEADLEE: Engine driven sprayers?

MR. J. S. HOUSER: Engine driven sprayers are better but in one case we obtained good results from a traction driven machine.

MR. T. J. HEADLEE: We have, during the past year, used against the pink and green aphis an engine-driven potato spraying machine, applied a mixture composed of 1 part of 40 per cent nicotine to 500 parts of water and soap at the rate of 2 to 5 pounds to 50 gallons, used a little better than 100 gallons to the acre with a pressure of 250 pounds and obtained excellent results in the destruction of the aphids.

MR. E. N. CORY: In Maryland we found that the infestation of aphids on potatoes was a fair indication of what we might expect later on the tomatoes. An examination of tomato seedlings is also a fair indication. We have not found it necessary to spray the potatoes.

MR. H. A. GOSSARD: I may mention one little trial that I made

this last summer against the potato aphid, using the same strength of sprays; I used a gasoline engine pump, giving about 100 pounds pressure and a rubber trailer, just the ordinary trailer hose. I guided the nozzle by hand and sprayed three or four rows of potatoes on each side of the sprayer. One application directed by hand against the lice cleaned them up in good order.

MR. T. J. HEADLEE: How many gallons to the acre did you use with that apparatus?

MR. H. A. GOSSARD: I used about 200 gallons or something like that on an eighth of an acre.

MR. T. J. HEADLEE: The year before last we used an ordinary sprayer against the false cabbage aphis on turnips which were 12 inches high and had assumed the recumbent habit. We found that by the time the lice were thoroughly wetted we had used 1,500 gallons to the acre, making the cost of the application so large as to render the treatment impracticable. With an engine-driven potato sprayer equipped with a lifting device we were able to cover plants of the same size with a little more than 100 gallons of spray mixture to the acre and to get excellent results in control of the aphis.

MR. W. E. BRITTON: I would like to inquire if this treatment was given for the aphid alone?

MR. H. A. GOSSARD: In most instances the sprays I used were combinations of nicotine, lead arsenate and Bordeaux. I didn't use soap where I used the Bordeaux.

MR. W. E. BRITTON: Did you use the sulphur in the nicotine?

MR. J. S. HOUSER: Most of the experimental work that we did was conducted from the standpoint of aphid control alone and not from the standpoint of developing a combined fungicide and aphicide. We therefore used no copper sulphate or lime sulphur, but employed nicotine sulphate, soap, etc., in various strengths and combinations.

PRESIDENT E. D. BALL: The paper by Mr. R. W. Chapman entitled, "Insects Affecting Wheat Flour and Wheat Flour Substitutes," will be read by Mr. W. A. Riley.

INSECTS IN RELATION TO WHEAT FLOUR AND WHEAT FLOUR SUBSTITUTES[1]

By R. N. CHAPMAN, *University of Minnesota.*

The ruling of the Federal Food Administration requiring the purchase of wheat flour substitutes with wheat flour called for the milling

[1] Published with the approval of the Director, as Paper 165 of the Journal Series of the Minnesota Agricultural Experiment Station.

and marketing of coarse flours in larger amounts than had ever before been attempted. The large flour milling interests of Minnesota predicted insect trouble and later the wholesale Grocers' Association and the Bakers' Association asked for help in protecting their stocks of wheat flour substitutes from insects.

In response to these requests work was carried on along two lines; the first, to meet the existing emergency by devising methods of protection, and the second, a study of the ecological relations of insects and the various flours and cereals. The relative susceptibility of different flours to insects is of prime importance in protecting them from insects, and a knowledge of susceptibility should be the foundation for a knowledge of protection.

The emergency work was mainly concerned with the consumers, for millers adopted measures of rapid transportation calculated to move the products to consumption before the eggs, if any were present, could hatch and cause damage. Circular letters issued through the office of the Federal Food Administration from Minnesota urged dealers to adopt the miller's plan of rapid handling and emphasized the necessity for cleanness in their warehouses.

The consumers did not benefit by the millers' and dealers' methods of rapid handling except in cases where only a few days supply of substitutes was on hand at a time. Where it was necessary to purchase larger supplies, the situation was most serious, for the rapid transportation often brought the eggs to the consumer all ready for hatching.

Housekeepers were advised to heat all their substitutes as soon as they were brought into the home in order to kill any eggs or larvæ which might be present. A method of heating to obtain a temperature fatal to insects and yet prevent the cereal from injury by overheating was devised as a result of a series of experiments. The temperature curves show differences in the different ovens used; but in all cases it was found that when the cereal was less than two inches deep in pans, and heated slowly until the surface temperature reached 85° C., the source of heat could be turned off, in the case of a gas, gasoline, or kerosene stove, or the oven door opened in the case of a coal or wood stove, and in the course of half an hour, the heat would diffuse throughout the cereal until all parts of it had passed well above the fatal temperature for insects.

For obtaining satisfactory results, it is essential that the cereal should be less than two inches deep in the pans, that the heating be done slowly with the fire as low as it will burn well in order to allow for the conduction of heat throughout the cereal, and that the heating be

stopped before a temperature has been reached which will injure the cereal (between 90° and 100° C.).

Since high temperature thermometers are not available for all housekeepers, a mixture of carnauba wax and paraffin has been devised which melts at the proper temperature for the surface of the flour. It is not the exact point at which the wax melts, but the melting of the piece of wax to a grease spot that is taken as the indicator. Therefore the piece of wax measures, not only the temperature attained, but also the time required for a certain amount of heat conduction, until the entire piece of wax has melted. Since temperature and time for heat conduction are the factors concerned in the uniform heating of the cereal, the wax may be even more satisfactory than thermometers, which register temperature only.

In practice, the method has proved to be very satisfactory, and is now being used in several states. When methods of rapid transit are followed systematically by the heating of cereals as soon as they are received by the consuming public, the losses which insects cause to these flours and cereals will be reduced to a minimum.

There are, however, certain difficulties to be contended with in the introduction of this method. The public must be acquainted with the method and impressed with its importance; in this the Federal Food Administration for Minnesota has coöperated. The wax must be made available for all, and in this matter the wholesale grocers cooperated in supplying their trade throughout the state, yet there were frequent complaints from those who were unable to obtain wax. To supply the demand the wax must be manufactured at a reasonable cost and yet conform to the requirements as to melting point and size of pieces. This matter has required constant attention but may now be placed on a more satisfactory basis when industry has returned to conditions of peace.

The bakers have experienced heavy losses and have required special attention and methods. Education in matters of cleanliness and a reform in some matters of handling flour have yielded good results. The exchange or refilling of used sacks has been found to be the source of much trouble. Experiments have shown that when empty sacks are placed in the oven, three or four deep on boards and left for five minutes, all the insects in them are killed at the usual temperature of 232° C. While it is necessary to watch the sacks closely to prevent scorching, this practice has given great relief. All rye proofing boxes and other utensils have likewise been heated in the oven with a result that badly infested bakeries have been entirely freed from insects.

The study of the relative susceptibility of the various flours and

cereals has consisted of experimental work in the laboratory and observational work in storehouses. The experimental work has proceeded on the assumption that other things being equal, susceptibility may be due either to the attraction which a cereal may offer to insects, influencing the number of insects which might invade it in the first place, or to the rate of development of the insects after entrance, which might result in an accumulation of the insects in great numbers.

In the study of the invasion, the various flours were placed in cylindrical jars with removable partitions, which divided each jar into five equal sectors. A different flour was placed in each sector, the partitions were removed, and the insects were placed in a depression in the center of the jar. Being thus surrounded by equal amounts of the different flours, the insects were free to express a choice if they had any.

The experiments were carried on in the dark and extended from a few hours to several days, the length of time making little difference after the first few hours, when the insects were exploring about. When an observation was to be made, the partitions were replaced and the contents of each sector removed, to count the insects contained in it. When one hundred insects were used in the experiment, the number found in a given cereal would be the percentage of relative susceptibility of that cereal as compared with the others used in the experiment.

The relations of *Tribolium confusum* to five grades of wheat flour and various wheat flour substitutes were studied in this way. The results of 25 experiments with adult beetles showed the following percentages: 1st Sizings, 10.6 per cent; 1st Middlings, 11.5 per cent; 1st Low Grade, 12.4 per cent; 1st Tailings, 14.6 per cent; 5th Bran, 52 per cent. The coarseness of these flours varies in the order named from the fine sizings to the bran. The experiments with larvæ did not show a variation greater than 7 or 8 per cent on either side of 20 per cent, the expectation, and consequently show no preference, for an average of about one-fifth of the total number of larvæ were found in each sector.

The results with the wheat flour susbtitutes showed no percentages constant enough to denote decided choice, either among the various substitutes or as compared with low grade wheat flour, so long as the coarseness remained about equal in all cereals. When the bran from rye meal was introduced into the experiments a decided percentage was noticed. It contained an average of 36 per cent of the beetles and was very constant, while the percentages found in the other portions were small and subject to greater variation. When coarse corn meal was used, no increase in percentage was found.

It seems, therefore, that a coarse, flaky material is more attractive

than a fine or granular material, and that the element of flakiness is, so far as choice is concerned, dominant over nutritive differences, if nutritive differences exist. To check this, some bran was ground to fineness and given an equal exposure to the beetles with the coarse bran. An average of 60 per cent of the beetles were found in the coarse bran and 40 per cent in the fine bran. Again four sections of a jar were filled with fine sawdust and the fifth with coarse sawdust. The sector with the coarse sawdust contained an average of 43.3 per cent of the beetles and the other sections averaged 15.3 per cent, 13.6 per cent, 12.2 per cent and 14.6 per cent respectively. It may therefore be concluded that the factor of coarseness is dominant and the factor of nutritive choice, if measurable, is less significant.

In the study of the relative development of the insects in the various wheat flours and substitutes, it was found that the larval life might be prolonged in certain wheat flour substitutes and that this prolongation took place in the last larval instar. In some cases the life-cycle was twice as long as in other cases. These experiments were all carried on under the same conditions, in an atmosphere of 70 per cent of relative humidity. (The temperature curve on the chart shows a drop of a few degrees near the end of the experiment, with a consequent prolongation of some of the pupal stages.) Further experiments now under way will furnish additional data on relative development.

The data accumulated from examinations of flour in warehouses have not yet reached the proportions which will give significant percentages, but the above results combined with general experience make it seem that coarseness is a factor in susceptibility. The fact that coarse cereals cannot be bolted through fine cloths together with the choice of the insects as shown in the invasion experiments substantiates this contention. The factor of relative development must await further investigations before its importance in influencing susceptibility can be judged.

MR. T. J. HEADLEE: Were any chemical studies made of the effect of heat on the flours, or feeds?

MR. W. A. RILEY: There were a number of experiments carried on, both by the chemists who were interested in the general effect on proteids and also by the home economists of the department, showing that there was no injury at this temperature.

VICE-PRESIDENT W. C. O'KANE: The next paper will be presented by Mr. W. E. Britton.

KEROSENE EMULSION VERSUS NICOTINE SOLUTION FOR COMBATING THE POTATO APHID

By W. E. Britton and M. P. Zappe, *New Haven, Conn.*

The outbreak of the potato aphid (*Macrosiphum solanifolii* Ashmead) was so severe in Connecticut in 1917 that much damage was done by it, or at least attributed to it, and the crop greatly lessened. Consequently we watched for this insect in 1918, and on its appearance warned the growers to be prepared to spray as soon as it promised to become sufficiently abundant to cause injury.

The first aphids were noticed at the Station farm, Mount Carmel, on June 11. Three days later (June 14) they were more numerous, and some were producing young. On June 15, they were observed to be present in potato fields in Greenwich. On June 18, a warning was sent out through the press associations. For several days thereafter, there seemed to be only a slight increase in the numbers of aphids, but during the last days of June they increased much faster and it was evident that something must be done to check them. Consequently on July 2 and 3 the potato field was sprayed with Bordeaux mixture, lead arsenate and nicotine solution, using "Black Leaf 40" at the rate of one-half pint in a barrel (fifty gallons) of the mixture. Though this spray killed some of them it was not very effective, as the waxy nature of the aphids repelled the spray causing it to roll away in drops.

We conducted several small experiments in hopes of finding some inexpensive material which could safely be used as a spreader in combination with the Bordeaux and lead arsenate. In this we were not very successful, and nothing seemed to take the place of soap which is commonly used when spraying to kill aphids only. Apparently there is always some danger of using soap in the combination mixture, as the arsenic may combine with the sodium or free alkali forming sodium arsenate and injury may result.

During the progress of applying these materials and watching results, the aphids continued to multiply throughout the field, and it soon became apparent that something must be done to check them, and done at once. Consequently all fields were sprayed from July 22 to 26. At this time, potatoes and tomatoes generally were threatened, and the demand for nicotine solution was so great that most retail dealers sold out their stock, and could not obtain more from the factory until too late to save the crops. Two or three dealers still had a small supply on hand but had raised the price, thus taking advantage of the situation.

We decided to spray with kerosene emulsion to kill aphids only and

demonstrate to the growers that they were not wholly dependent on nicotine solution. A common formula for kerosene emulsion and the one recommended on our spray calendar calls for one-half pound of soap and two gallons of kerosene to make thirty gallons. In this formula the soap seemed to be insufficient for the kerosene, so we increased the proportions somewhat. We also doubled the amounts of soap and kerosene but instead of making sixty gallons, diluted it less, to make fifty gallons, the right quantity to fill the spray barrel. Laundry soap was purchased by the box at wholesale prices, and the amounts of materials used were as follows:

Kerosene	4 gallons
Laundry soap (about 30 ounces)	3 cakes
Hot water	2 gallons

After churning, dilute to make fifty gallons. The soap was shaved into thin slices with a tool for shredding cabbages, and was dissolved in water on a stove set up in the field for this purpose. It was then mixed with the kerosene and churned back and forth through a small tube under pressure by means of a bucket pump with the hose directed back into the liquid, after which it was transferred into the pump barrel and sprayed upon the plants with hand-power barrel pump with spray rods bent at an angle of forty-five degrees near the nozzles.

This emulsion was effective, and all aphids hit by the spray were killed. A part of one field was sprayed with nicotine solution and soap for comparison. Some of the men who applied the mixture thought that slight injury was caused by the kerosene emulsion, but the same thing could be detected on some of the plants before they were sprayed. The variety was "Gold Coin," and there were many mosaic plants in the field; the tissues break down and the leaves turn brown earlier on these plants and this is probably the explanation of the injury rather than the spray.

A press notice was issued advising growers to spray at once with kerosene emulsion in order to save their crops, and to show them that they were not absolutely dependent upon nicotine solution. The comparative costs of the two mixtures are about as follows:

KEROSENE EMULSION

4 gallons kerosene at .14 (retail)	$.56
3 cakes soap at .06 (wholesale)	.18
Total	$.74

NICOTINE SOLUTION

Nicotine sulphate ("Black Leaf 40") 1 pint (by the gallon)	$1.31
Soap 3 cakes at .06 (wholesale)	.18
Total	$1.49

Though the materials for the nicotine solution cost fully twice as much as for the kerosene emulsion, it required a little less work in preparation. The materials for kerosene emulsion could be obtained from any grocer in city or country, but nicotine solution was difficult to obtain promptly, and had become scarce in Connecticut on account of the unusual demand for it.

MR. T. H. PARKS: I would like to ask Dr. Britton if he had any visible burning or ill effects from combining nicotine sulphate with arsenate of lead and soap.

MR. W. E. BRITTON: We didn't dare try it on a large field. We tried it on a few rows and saw some injury, though very slight. Of course the field had been sprayed previously with arsenate of lead, even where we used the nicotine solution and soap to kill aphids only.

MR. J. S. HOUSER: We had one group of growers in eastern Ohio, who thought that the melting of the soap was too much bother, and they used washing powder, in combination with the nicotine sulphate and got results comparable to those obtained from the use of nicotine sulphate and laundry soap chipped and dissolved. I would like to ask if any of the entomologists here had experience of that kind; it facilitates the operation wonderfully because you don't have to bother with the fire and dissolving your soap if you use common washing powder.

MR. W. A. RILEY: It seems to me that in the work of Mr. Moore, Mr. Graham and Mr. Marcovitch, which was interrupted by the war, but the preliminary results of which were published in the *Journal of Agricultural Research*, they show that you might as well use the powder as soap. In other words the washing powder just as the soaps and various kerosenes used are likely to give good results, but the essential parts of their work was to show that the variation in kerosenes on the market was so astonishing that the variations and results obtainable from the sprays from the kerosene emulsions could be accounted for in many cases by these variations in the composition of the kerosenes that were available on the market, and likewise that the soaps differed enough to give astonishingly different results, depending upon the soap that was used.

For an illustration, in one of the common formulæ published, there is the recommendation of using ivory soap. Without knowing the details of Mr. Moore's work sufficiently to point it out, he found that this was not only useless, but nullified the effect of the particular spray that it was recommended in. And so it is perfectly clear from his results that in order to know what to recommend in the way of these

different compositions, we must standardize the ingredients, and that it will be perfectly easy for some of the big oil companies to put out a standardized kerosene, meeting best the requirements that are needed for this particular work.

MR. C. R. CROSBY: I would like to ask Dr. Britton what results he got from using blackleaf with the Bordeaux.

MR. W. E. BRITTON: We couldn't see that it sprayed much better than the blackleaf and water alone. Of course that can be modified somewhat by using greater pressure in the pump. We had a hand outfit. I suppose the pressure was between 75 and 100 pounds.

MR. W. H. GOODWIN: May I ask what make of pump you used?

MR. W. E. BRITTON: I think the pump was one of the Hardie pumps, using two lines of hose. We used the "Friend" disk nozzle with rather small hole.

MR. W. H. GOODWIN: The reason I ask this question is that different makes of nozzles and pumps give vastly different results. Spray solution may be effective or ineffective due largely to the force with which it is applied, its fineness, and the liberality in the quantities of spray used. An apparent excess per acre usually more than pays in the results obtained. Nozzles throwing a hollow cone spray require considerable care in handling them in order to get every bit of foliage sprayed covered evenly and forcefully with spray.

MR. W. E. BRITTON: The same outfit was used in spraying with the nicotine solution, the arsenate of lead and the Bordeaux, and also in the nicotine solution with soap.

MR. W. H. GOODWIN: In some of my experiments I have found I can apply a much weaker spray solution by applying more spray per acre, and produce satisfactory results, provided I apply enough force behind the spray to get a thorough cover.

MR. T. J. HEADLEE: The Kentucky Tobacco Products Company, the makers of "Black-Leaf 40," recommend for aphis a mixture composed of 1 part of the "Black-Leaf 40" to 1,000 parts of water with the addition of two or more pounds of soap to each 50 gallons. Even when applied with an engine-driven potato sprayer this formula has been with us an absolute failure. In spite of these facts, however, the company has until recently persisted in the recommendation. I am making these statements in the hope that Mr. Safro will explain the action of the company.

MR. SAFRO: Before discussing this matter I would like to go back to Professor Houser's question, which did not seem to be answered as I thought it would be. His question was in regard to the use of washing powder as a spreader. Before going further, I want to make this state-

ment: for the last fifteen months I have not been in touch with entomological progress; if, therefore, something has developed within that time that is new, I am not acquainted with it.

A main function of soap is as a carrier. The alkali itself, or a washing powder will do admirably as a softener provided it is strong enough to function properly and not strong enough to hurt the plant. That is the reason we use soap—because of the wider margin of safety. The composition of soap is so uncertain that it must have a very wide margin of safety. You may use more than is necessary to function properly, and yet not injure the plant. The idea of using the soap is to use something that you can vary in amount, because there are no two soaps that are really so definite in composition that you can accurately say, "Use so many ounces."

Of course, in effect, we do say that; but it is not accurate. We have powders that are excellent spreaders, but it would be necessary to recommend a certain powder in one locality and another brand in another place. The brand would have to differ with the character of the water used.

Our biggest problem has been that of water as a spray-carrier. It is suggested that some entomologists could profitably specialize on waters, hard and soft waters. We have had to contend with waters in Arizona and Southern California, in parts of Colorado, in Idaho, and in the Northwest generally that were almost unbelievably hard.

Washing soda will be effective as a softener if it is used accurately for the particular water employed; but such accuracy is often not practical and the reason for preferring soap instead is to employ a substance that is comparatively safe.

An entomologist made a statement the other day which all of us should bear in mind. He said that he is working on the economic entomological problems of the farmer from the standpoint of the farmer —and this is a standpoint that certainly does deserve a great deal of consideration. Dr. Felt this morning stated that as entomologists we are independent. I sometimes fear we tend to be too independent. We do not coöperate sufficiently. Too often we work along, entirely forgetting the farmer's attitude—the item of labor, the item of mechanics, other items that a farmer thinks of, and that entomologists sometimes forget.

Those of you who have soap factories in your states should bear in mind that within short distances of the factories you can distribute and use, what the soap factory people call, I believe, the first boiling; it is really a soft soap, and is much cheaper than the finished product. All the boiling beyond that point merely puts the soap into condition that causes more trouble for the farmer in restoring it to its former liquid

condition. In southern California we used cottonseed oil soap, that is the first boiling.

The human nature of this whole problem from the farmer's standpoint is the fact that if he can avoid actually having to mix something, weigh something or measure something, he is going to get out of it regardless of a lot of other factors. Tell a man to cook something that may take only five minutes of his time and if he can get out of that by doing something easier, even if the other thing may not be as effective, it is human nature for him to do the other thing. You and I do it. We can all shine our own shoes, but generally we get somebody else to do it, and pay for the work.

I have sometimes wished that somebody would write an article on commercial recommendations and their bearing on biological recommendations. I think that, perhaps, would solve the problem. Very often in the laboratory something will happen that out in the field will not, and I think the difference of opinion regarding dilutions comes under that heading. In other words, a certain nicotine content will kill the pest, say, aphis, if that aphis is thoroughly covered with it. Now, then, it becomes a problem, whether to be more thorough in your work or try to cover up the sins of negligence by increased strength. I mean the sins of negligence on the part of the grower.

I wish some of those that have had experience within the past year would tell the grower to do the work thoroughly or try to cover it up by using a stronger dilution. I understand that in actual tests Professor Headlee found that a dilution of Black Leaf 40 of one to eight hundred would kill aphis in the laboratory. It seems to be thoroughness versus strength and you and I as thinking men are going to differ on some items. Here is a chance for each man to decide what he is going to do, to choose thoroughness or by increased strength to hide the lack of it.

In additional discussion of the soap problem: it has generally been understood that arsenates and soaps should not be mixed. The reason is that in some places many of us have actually seen cases of injury. Now it is the one case of injury that establishes the rule; it is not the thousand cases of no injury.

The more recent development I know only from conversation with several entomologists,—and that is, that such a combination is now considered safe. That is all I know about it. It is on good authority. It may be that the arsenates have been standardized better than they were before. But up to fifteen months ago the status was that though there is only one chance in a hundred that there will be any injury following such a combination, because of that one chance, we have always been advised not to use it. However, that is superseded by the later announcement that arsenates and soaps can be mixed.

MR. W. E. BRITTON: I understand that the nicotine solution with soap and lead arsenate has been used in Massachusetts and has been recommended there; that while there may be occasional injuries, it isn't necessary to take it into consideration as compared with the injury done by the aphis.

I wish to say one word in regard to the question of the supply of nicotine solution. I am told by a man representing the Kentucky Tobacco Products Company, that they have arranged to have a supply in each state, so that the situation that I mentioned as occurring in Connecticut will probably not occur again.

Mr. Safro made one statement; he said the use of soap is for the purpose of obtaining the alkali. It is necessary to have some grease with it. That is, you would not recommend household lye in connection with nicotine alone, would you?

MR. V. I. SAFRO: I wouldn't recommend it, but it will do if it is used accurately. An entomologist can use household lye. In the northwest, where some of the growers are as careful and as painstaking as we are, they can use lye safely, but you certainly wouldn't recommend it to a grower, under the penalty of being forever discredited.

MR. T. H. PARKS: I am particularly interested in Dr. Britton's talk because what I am after is to get the farmers to put on this spray and not get scared at the expense, and that is what they did in Ohio last year. If we can safely use kerosene emulsion as a substitute for tobacco sprays we shall have more people spraying to solve the potato aphis problem.

Last year I noticed that many would apply one spray and then if they did not get results they would quit. I had read Professor William Moore's article in the June number of the JOURNAL. He combined oleic acid (red oil) with a 40 per cent nicotine solution which made the tobacco spray cheaper. I tested this in the field according to Professor Moore's formula, though we were able to purchase only a few ounces of oleic acid. When this spray (nicotine oleate) was applied as strong as 1 part to 500 of water, it did the work as well as Black-Leaf 40 (1–500) plus soap (2 pounds). Weaker strengths of nicotine oleate were not satisfactory. I figured out the difference in the cost and it was favorable for the new spray. I then got in touch with one of our commercial insecticide companies and obtained the wholesale price of oleic acid f. o. b. New York.

Later in spraying for turnip aphis we experimented with Black-Leaf 40 and soap at various strengths in comparison with this Black-Leaf 40 and oleic acid combination at different strengths. Here it was found that Black-Leaf 40 (1–800) and soap (2 pounds) when used thoroughly did the work and did it well. The weakest nicotine oleate

strength that was effective was again found to be 1–500. When I figured the expense of these two combinations there was such a little difference in favor of the new mixture that I gave up the idea of trying to get our farmers to use it.

Now I am going to emphasize thoroughness first, and sprays no stronger than known to be satisfactory if they are applied thoroughly. If we can trust kerosene emulsion in the hands of farmers it will help solve the cost of repeated spraying to control potato aphis.

MR. E. N. CORY: I want to give our experience in regard to the strength of Black-Leaf 40 that is required. Where we supervised work we were able to get results with Black-Leaf 40 at the rate of 1 part to 800 parts of water, but the farmers did not get results by using this strength. They doubled the amount of Black-Leaf 40 and in many cases secured excellent results. To them it was simply a problem of getting control, rather than a matter of cost, as they were growing tomatoes under contract and the price was excellent. Many of them stated it was not a question of the cost of the insecticide, but a question of killing the lice.

I would like to ask in regard to the effect last year of parasites and lady-beetles in destroying aphids. We found that toward the end of the infestation, or in fact at the height of infestation, the lady-beetles were doing excellent work and this was a question in the mind of many farmers as to whether parasites were not effective in control rather than spraying.

MR. C. P. GILLETTE: I have done a good deal of work in controlling plant lice in Colorado, and have found that if the application does not kill, it is because the body of the aphid is not thoroughly wet with the insecticide. I once gave a student some Black-Leaf 40 for use in killing the black chrysanthemum aphids in the greenhouse. He reported that he could not kill them with any strength that he used. I made a test and found that I could not kill this aphid, but if soap was added to the water good results were secured. If it was not used very little of the spray would remain on the bodies of the aphids. One part of Black-Leaf 40 to 1,000 parts of water is sufficient to kill them, if their bodies are thoroughly wet.

MR. T. J. HEADLEE: Our experience with vegetable plant lice during the past season has raised the following questions: (1) Is it possible in all the species attacking vegetables to discover the infestation while the plants are yet small before they have had a chance to assume a recumbent habit and by a single thorough treatment of any of these crops bring the aphis under control? (2) What sort of apparatus must be used, what sort of formula, what pressure and how many gallons must be used on an acre?

MR. L. B. SMITH: In eastern Virginia we have viviparous females occurring throughout the year. Our most serious outbreaks of the green peach aphis occur during the winter. At certain times they will be scarce, then, as Dr. Headlee described, the aphids will appear in enormous numbers. The thirty-first of October of this year was particularly warm; the air was filled with winged forms of the pink and green aphid which were apparently migrating from weeds and kale to young spinach plants. The spinach became heavily infested and the outbreak was so serious that by November 25, several shipments were seized by the health authorities in New York City. The yield was also cut severely. At the present time, as a result of the outbreak of aphids, there is occurring an epidemic of the disease known as spinach blight. I believe the southern conditions influencing the development of aphids are quite different from those further north where the sexual forms are produced. If the conditions which cause the outbreaks can be foreseen and the control measures applied in time, it will undoubtedly save in a great measure some of the losses which now occur.

We have recently perfected a means of spraying young spinach plants. Spinach is a low-growing plant and is difficult to spray effectively. By using a gasoline outfit and maintaining sufficient pressure, we have been able to get very good control of the aphids this fall. I might also say that in spraying for the control of the green pea aphid, the pink and green aphid of potato and the green peach aphis, our results have been similar to Dr. Headlee's, we have had to use strong solutions. With the most careful spraying it is impossible to soak every aphid on a plant, particularly spinach or potatoes, when the leaves are savoyed or curled, with any arrangement of nozzle that we have been using. By having a solution with the proper wetting power, so that when the spray strikes the aphid it will form in a film, good results can be obtained by using the stronger solution. Under field conditions, on the crops mentioned, we have not had good results with Black-Leaf 40 diluted more than one to six-fifty, unless excess quantities of soap are added.

MR. P. J. PARROTT: The entomologists in New York, during the last fifteen or twenty years, have been called upon at different times to carry on some very extensive work against sucking insects, such as the apple red bugs, the pear psylla and several species of plant lice, particularly those attacking apple trees and cabbage. What spray to recommend to a farmer is oftentimes a puzzling question, because in addition to effectiveness, one must also consider economy and safety. It is the general opinion of the entomologists of New York that the great merit of the nicotine spray is its safeness. Before the nicotine

sulphate was introduced we used to have to rely on soaps and kerosene emulsion, and I recall very distinctly that a lot of damage was done to cabbages and fruit trees by kerosene emulsion. Later, when the oil sprays were abandoned in favor of soap, we were then confronted with this fact: that soaps varied tremendously in their important constituents. Our chemists showed that the water content varied from 8 to 60 per cent and, on account of the variation in soap, we were forced, in spite of the cost of nicotine sulphate, to recommend it.

The experiences that have been related in regard to aphids show the great need of thorough-going studies of the life-histories and habits of the various species and business experiments to develop methods of control that are economical and efficient. As regards the strength of the nicotine sulphate, we generally recommend one part to a thousand parts of water, and rarely one to eight hundred. In considering dilution, I would also emphasize the importance of timeliness and thoroughness of the treatment.

MR. W. C. O'KANE: I would like to ask the gentleman, what are you recommending for the spraying of apple foliage where you need to use a stomach poison as an early spray, either the pink spray or the calyx spray, and at the same time have a big infestation of aphids coming on?

MR. P. J. PARROTT: My answer to your question is that if farmers were following my instructions they would not find it necessary to use soap in the pink spray. We are working on the proposition that they should make a delayed dormant application. Of course I realize that various workers differ on that point, but we have carried on experiments on eight and a half acres in Geneva now for the last five years and we have had no difficulty whatsoever in securing an almost complete killing of the different species of apple lice.

MR. W. C. O'KANE: How late were you delaying your application for that purpose?

MR. P. J. PARROTT: Until the leaves of the advanced buds are about one quarter to a half inch.

MR. W. H. GOODWIN: The single variety of apples?

MR. P. J. PARROTT: Our work on Station grounds has been entirely with Rome apples, but there is considerable experimental data to show that in blocks of solid varieties, like Greenings or Baldwins, which constitute 60 to 70 per cent of the apples grown in New York, the same results can be obtained; that is, the grower can obtain commercial control of the insect.

MR. T. J. HEADLEE: Our experience on the point raised by O'Kane is that it does not make any difference whether the eggs of the apple aphis have hatched or not, because at the green bud stage the

outer covering of the egg has split and the egg has become very susceptible to destruction by the delayed winter-strength lime-sulphur and nicotine treatment. Our experience of the past three years shows that the eggs of the rosy apple aphis and of the green apple aphis have not all hatched by the time the green bud stage has been reached. We endorse the recommendation of Professor Parrott that the trees be thoroughly sprayed at the green bud stage with a mixture composed of winter-strength lime-sulphur and nicotine because the eggs which have not yet hatched are at that time in a very susceptible condition. We do not agree, however, with Professor Parrott in that the nicotine should be used at the rate of 1 to 1,000, but have been compelled, by the evidence of three years' experience, to advise adding 40 per cent nicotine to winter-strength lime-sulphur at the rate of 1 to 500. It may be that the difference between our experience and that of Professor Parrott is due to ecological difference, incident to the difference in geography.

MR. P. J. PARROTT: Do you use that one to eight?

MR. T. J. HEADLEE: We used 1 part of the commercial lime-sulphur to 9 parts of water and added to it 40 per cent nicotine at the rate of 1 to 500.

MR. C. P. GILLETTE: The peach aphis hatches very early in the season. It is not uncommon to find mothers giving birth to the young by the time the buds are open. They can be killed on any of the pit fruits such as peach, plum or cherry by an early spray. The false cabbage aphis is in Colorado an inhabitant of Cruciferous plants. The peach aphis is the most general feeder that we have as it feeds on something like 75 host plants.

Adjournment.

Morning Session, Friday, December 27, 1918, 10.35 a. m.

The association met in joint session with the Section on Horticultural Inspection. Mr. E. C. Cotton, Chairman of the Section, presided.

VICE-PRESIDENT E. C. COTTON: As I have not prepared an address for this occasion, we will listen to the papers listed on the program. The following paper will be read by Mr. E. N. Cory, on "The Status of the Oriental Peach Moth."

THE STATUS OF THE ORIENTAL PEACH MOTH[1]

By E. N. CORY, *College Park, Md.*

Grave apprehensions were entertained in the last few years as to the damage which might result from the establishment of *Laspeyresia*

[1] Contribution from the Maryland State College of Agriculture.

molesta in several of the states on the Eastern Seaboard. Judging by our first information in regard to the pest, these fears were well founded. The fruit-feeding habit seemed most serious and the progress of the infestation has been carefully watched and further dissemination guarded against in some instances.

After three years' observation and investigation certain facts have come to light that lead to the belief that the pest may finally come to have approximately the same destructive status for peach as the codling-moth has at present for the apple in well-cared-for eastern orchards. At most, its destructive force should be no greater.

This estimate is based principally upon the counts made at College Park by Dr. Garman of the infested fruits and in part on the comparative growth of infested and non-infested trees.

In the face of a long standing infestation which would be rated as of considerable severity, the fruit from the following varieties showed the percentages of infestation to be quite small. Except in three cases, the per cent of infested fruits did not amount to over 5 per cent. Champion with 12 per cent infested fruit, Lyon with 13 per cent and another late variety with 35 per cent were the exceptions. The average infestation on Greensboro, Carmen, Champion, Elberta, Late Crawford, Mountain Rose, Lyon and the unknown variety was 4.3 per cent based on actual counts of over 4,000 peaches.

It may be possible to reduce this fruit infestation even more. Spraying experiments show that the dry particles of self-boiled lime sulfur will kill newly hatched larvæ that attempt to crawl through them. Dusting, therefore, may give greater control than spraying.

The comparative growth of infested and non-infested twigs on bearing trees shows only a slight advantage to the infested tree. Careful measurements show that the average growth of infested twigs for the season was 11.1 and for the non-infested twigs 8.8 inches. The difference in this case of only 2.3 inches is hardly worthy of serious consideration.

Another factor that may have a very considerable influence on the potential destructiveness of the insect is that of parasitism. Eight parasites, one of the egg and the balance of larva and pupa, during the past season contributed to the control of the pest. Approximately 60 per cent of the eggs were parasitized by *Trichogramma minuta* Riley. About 50 per cent of the larvæ and pupæ were also parasitized. This leaves a possible one fifth of the normal brood as survivors. The egg parasitism in 1917 was 80 per cent; so that it seems fair to assume that a high percentage of parasitism may reasonably be expected, particularly since *Trichogramma* is a general feeder. Five of the parasites were Hymenoptera and three Diptera.

Control experiments are quite variable in their results. The question of how much arsenical spray a peach tree will stand as well as the actual value of its application is involved.

The effect of various insecticides on the egg is interesting. Nicotine sulfate at 1–500 or 1–800 alone gives about 70 per cent mortality and in combination with self-boiled lime sulfur, arsenate of lime and lime caseinate is equally as effective in laboratory tests. Field tests show that even better results may be obtained. In one instance only three infested twigs were found on a sprayed tree while thirty were taken from a tree of the same size along side of the sprayed tree. Apparently the timely application of the proper insecticide will control the pest but the question of economy in spraying and the possible results to the tree will bear close scrutiny.

One of the most serious points to be considered is the feeding in apples by the late broods. Apparently this is one of the greatest sources for over wintering forms, at least in young trees adjacent to apple orchards.

The confining of the pest to its present limits seems to be scarcely possible owing to the fact that infested fruit serves as the greatest potential source of dissemination. Measures of quarantine that disregard fruit are not likely to be successful in checking the spread of the pest. Nursery stock usually has smooth bark and probably is seldom used for pupation. Pupation is more likely to occur in the ground than on smooth bark trees.

In view of the facts set forth, it would seem that unless unforseen circumstances alter the present habits of the pest, that it is little to be feared. The insect should be considered in the same light that we consider the codling-moth as far as the orchard is concerned and in nurseries it should be treated as any other nursery pest. That is to say that every precaution of inspection should be utilized to prevent its dissemination on the stocks.

VICE-PRESIDENT E. C. COTTON: This is one of our new pests and I trust this paper will be thoroughly discussed.

MR. P. J. PARROTT: I am wondering if there are any of the Federal workers here who can report what they found in their effort to determine the destruction of the species. One agent visited Geneva, N. Y., and spent a number of days inspecting nurseries and orchards in that vicinity. He then visited Rochester and Buffalo, but I haven't heard as to the results of the examinations that were made.

MR. W. B. WOOD: I do not have the records here, but as I remember it, I think I can give you practically the way the inspection results

stand. The inspections were made throughout most of the states. There were a few that we were not able to touch. In the eastern states the pest was found in the vicinity of Washington, both in Maryland and Virginia, and in the vicinity of Baltimore. It was found in southern Pennsylvania, east of the middle of the state; it was found in New Jersey, in the southern end of New York state; it was found on Long Island, and at one point in Connecticut. Outside of these localities the insect was not found. It was not found in northern or western New York, although we found there what we term "typical injury." This same type of injury was found in a great many other places that were inspected, but I believe that the injury is caused by *Anarsia lineatella* in these cases.

This insect injures the trees in exactly the same manner, and we feel that we are unable to tell from the injury which insect causes the trouble. The results of the inspection that we have made were based altogether on the insects that were collected. In no place did we report the insect as being found where it was not collected but where typical injury was present. It may be established in other localities that were missed, but as far as we know, this was the general result—the insect being present only in a few of the states along the eastern seaboard, from Connecticut south to Virginia, a short way south of Washington.

VICE-PRESIDENT E. C. COTTON: The fact that the insect was not found, of course, was no proof that it does not occur there, because as I understand it, the surveys were made in a general manner rather than in a thorough manner.

MR. W. B. WOOD: The surveys were made in most cases very generally, and the insect could very well be missed.

MR. S. M. FROST: I would like to ask if the injury might not be due to the tarnished plant bug on peach, or could it not be attributed to a Lepidopterous insect?

MR. W. B. WOOD: In the case of the boring of the Lepidopterous insect, *Laspeyresia molesta*, the twigs are, I think, always hollowed out on the inside; with the injury from the plant bug I don't believe this would be the case. I have often noticed injury that was attributed to the plant bug, and it was quite different from that caused by *molesta*, the twigs always being hollowed out by the latter insect.

VICE-PRESIDENT E. C. COTTON: The next title is "Control Work Against the Japanese Beetle," by W. H. Goodwin.

CONTROL WORK AGAINST THE JAPANESE BEETLE

By W. H. GOODWIN, *New Brunswick, N. J.*

(Withdrawn for publication elsewhere.)

MR. W. H. GOODWIN: The plans for the coming season are much larger. There is to be considerable increase in the equipment, and following somewhat of a similar plan as we have followed in the past season, including the addition of several trucks, and another tractor, and six or eight tanks for the treatment of the grubs with a solution of sodium cyanide. We have tried putting crystal cyanide in the ground, but as yet results have not been good. There is one other method that could be used in this problem and that is taking over something like fifteen thousand acres, and simply paying those farmers so much for their crop, and putting the entire thing under cultivation and keeping it absolutely polluted with poison where there are field crops. If we could actually take those farms over and keep them under cultivation throughout the season I think we could eradicate this pest within a year.

VICE-PRESIDENT E. C. COTTON: Does anyone wish to ask any questions or discuss this paper?

MR. E. P. FELT: I would like to ask Mr. Goodwin whether it would not be cheaper in the long run to adopt the drastic measure which he suggested at the close of his remarks, and simply eliminate, within practical limits, all vegetation?

MR. W. H. GOODWIN: That would be much cheaper in the long run, but it means an initial outlay of possibly three or four hundred thousand dollars. That country produces some money; in that section they fertilize heavily and they crop with a succession of crops, which makes the total income from an acre very high, and they get top-notch prices in the market at either Philadelphia or New York.

MR. E. R. SASSCER: I would like to ask Mr. Goodwin if the presence of that cyanide solution in the soil has any effect on the growth of the plant.

MR. W. H. GOODWIN: As far as we can tell, there is absolutely no effect and no injury where we use a solution of one ounce to fifteen gallons of water. We need that amount of water to penetrate, and lack of penetration seems to be the fault of drilling the cyanide into the ground. I don't believe we could use cyanide drilled in the ground except in the fall, and we haven't tested any method extensively excepting in the fall.

MR. E. R. SASSCER: There is one other point in this paper that interested me, and that is in regard to the attraction of the beetle to the light. I remember when this insect was first discovered in New Jersey I had occasion to look up the literature on this beetle, and I was not very successful, but I found among the papers examined a short note on *Adoretus tenuimaculatus*, a related insect, which is now established in

Hawaii, and as I recall lights were placed around valuable plants at night to keep the insects away. It seems that the adults do not feed after midnight and the lights are then extinguished.

MR. W. H. GOODWIN: I won't vouch for this translation at all, but what is translated from the Japanese is that they were strongly attracted by lights, and that was one of the ways of catching the beetles. With us, trap lights were a complete failure. I have found beetles repeatedly within ten to twelve feet of lights that are only four feet above the ground, and they were not the least bit disturbed or attracted by the strong light.

VICE-PRESIDENT E. C. COTTON: I would like to ask Mr. Goodwin if he has tried other soil fumigants.

MR. W. H. GOODWIN: We used carbon bi-sulphide on azaleas, and got serious injury. That soil is sandy and loose, and makes it extremely difficult to get any satisfactory results with carbon bi-sulphide unless the soil is very wet.

MR. J. G. SANDERS: In the case of some of our closely allied American beetles, they fly long distances, and they quickly retire. I wonder if it is the same with the Japanese beetle.

MR. W. H. GOODWIN: You can occasionally follow them with field glasses. They seem to settle within a few hundred feet. They simply riddle flowers, hollyhocks, and things of that sort, and roses. They simply chew them up, in other words. They are such general feeders that it makes the problem much more complicated because they will feed on any plant, except grass and corn, and a few things like that. They bore into the ends of corn ears, going down around the silks, and there is where the danger comes in transporting them, when that corn is cut and carried into the markets.

VICE-PRESIDENT E. C. COTTON: The next paper is entitled, "The Discovery of the European Potato Wart Disease in Pennsylvania," by Mr. J. G. Sanders.

THE DISCOVERY OF EUROPEAN POTATO WART DISEASE IN PENNSYLVANIA

(Plate 3, figure 2.)

By J. G. SANDERS, *Economic Zoölogist, Harrisburg, Pa.*

The discovery of the European potato wart disease [1] in Luzerne County, Pennsylvania, late in September, 1918, was a distinct surprise to all whose interest is concerned in such matters, although a constant watch has been maintained for the appearance of this dangerous pest within our borders for several years.

[1] *Chrysophlyctis endobiotica* Schilbersky. Described in 1896.

Greater interest must attach to the fact that this disease has been firmly established for at least eight years in an unusual situation, where it might have continued undetected for several years longer except for its almost accidental discovery.

Hidden away in the gardens of the small mining villages, where the consumption of potatoes much exceeds the production, the disease might have continued its advance for a few years to other localities similarly situated, without spreading to the larger potato-growing districts nearby, where eventually it would have appeared in our public markets, and attracted the attention of inspectors and the more enlightened growers.

Immediately following the discovery of the disease, the writer went to Washington and conferred with Dr. W. A. Orton of the Bureau of Plant Industry, to secure the assistance of trained men to aid in our survey, which must be hurriedly carried out because potato digging was already starting in the Hazleton district, which lies at an altitude varying from 1,600 to 2,000 feet elevation. Doctor Orton, keenly alive to the dangerous situation, sent several of his trained men, and called on several plant pathologists who had been engaged in the Federal plant disease survey, to aid in the work. Field men of the Pennsylvania Bureau of Zoölogy were called in as rapidly as possible, and in about six weeks, approximately three hundred mining villages, towns and cities were hastily surveyed by garden inspections. At the close of our season's work, a total of twenty-eight villages and towns were found infected in varying degrees, a few having only one, two or three gardens showing the disease.

The origin of this disease, and a few facts of its possibilities of dispersion will be of interest. The Federal Horticultural Board, as one of its first official acts, fixed on September 20, 1912, a quarantine on further entry of European potatoes to the United States; yet its power granted by Congress came too late to avert the entry of this disease, which we must now fight with all power and ability at our command, to safeguard our most important vegetable crop.

Inquiries from the villagers, mostly Slovaks and Polish and allied races, with a few Italians, determined the fact that most of their potatoes had been bought from the company stores of the coal mining companies, who in turn had purchased largely from the Hazleton Produce Company. Following this information, it was learned that considerable quantities, several carloads, of German potatoes had been bought and sold by them in 1911 and early 1912, and hence our evidence was sufficient. Our next problem was to determine as rapidly as possible the limits of the spread of the disease; and we felt, after a preliminary survey in which we found much disease, that it must also

be scattered throughout our larger anthracite coal mining area, covering a large area of northeastern Pennsylvania. It is a pleasing report that we can offer now, that no other centers of infection exist, as far as our present knowledge goes, although subsequent inspection may reveal it at other points.

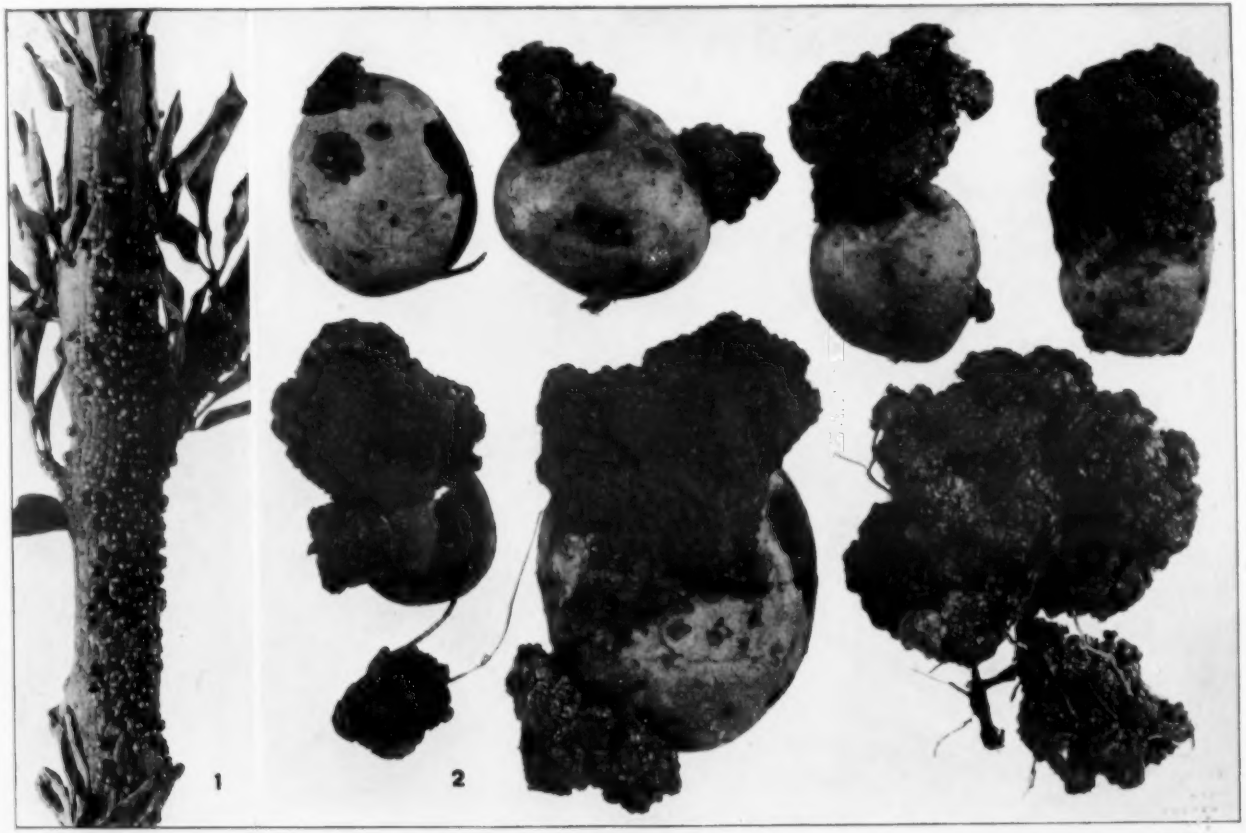
The finding of this disease in such peculiar and unsuspected places will at once caution our inspectors to look for it in similar localities, where the demand for potatoes far exceeds the local production, and to which points foreign potatoes may have come to supply the demands in years of short crops. Especially important, it seems, is a careful inspection in gardens of our larger cities and their suburbs, and of larger manufacturing centers, which should be carried out next summer and autumn with as much care and speed as possible. Our eastern states should immediately secure special appropriations for such surveys, so that no time will be lost in rounding up the pest.

Originally described from Hungary by Professor Schilbersky in 1896, and first brought to public attention, the potato wart disease has rapidly spread through Hungary and Germany into the British Isles and Norway, and there is strong probability that under the war conditions for the past four years, the pest has been even more widely spread than our present records would indicate. Late reports from England show that tremendous spread of the disease has obtained on account of the lack of inspection facilities during the war period, and that the loss, in consequence, has been very heavy. The disease was introduced into Newfoundland, at the islands of Saints Pierre and Miquelon, but the Pennsylvania record is the first for the United States.

The wart disease belongs to one of the lower families of fungi, the *Olpidiaceæ*, and is closely allied to the *Synchytriums*—formerly having been classified in this group. Fortunately, the disease is known to attack but one plant other than the common potato, *Solanum tuberosum*, and its varieties; and even tomato plants growing in very badly diseased soil in the Pennsylvania infections, showed no trace of the attack of the potato wart disease. Bitter-sweet is slightly affected.

Numerous publications and references to this dangerous disease have appeared in European literature, but up to the present little has appeared in American literature. Circular No. 52 of the Bureau of Plant Industry, by W. A. Orton and Ethel C. Field, discusses briefly the wart disease of the potato, its nature and distribution, along with three excellent halftones, as well as a list of the more important literature pertaining to this disease published since 1896.

All portions of the potato plant may be attacked by this pest, but more frequently it is apparent on the underground portions of the stem, roots and tubers. It attacks the tuber usually at or near the



1. *Lecanium prunastri* Fonsc. The globular fruit scale on plum twig.
2. *Chrysophlyctis endobiotica* Schilb. European wart disease of potatoes from Europe, established about Hazleton, Luzerne Co., Pa.

"eye," and there rapidly develops a very distinct, warty growth, usually brownish in color. These warty growths enlarge rapidly, and ultimately cover and transform the entire potato to a warty mass, somewhat resembling a piece of cauliflower head. This stage having been reached, the warty mass decays in the ground, thereby releasing myriads of thick, heavy walled spores, which remain viable in the soil, according to experiments carried on in Europe, for more than six years —even in the absence of potato growth. In other words, the disease has appeared after a six-year rotation of crops other than potatoes, and has attacked potatoes planted the following season. No definite records are available regarding the exact longevity of the spores in the soil, though it is highly probable that a ten-year period must elapse before infected soil can be considered absolutely safe for potato planting.

The disease can be transferred to clean soil in several ways, most important of which are through infected seed potatoes, infected parings, spring freshets carrying infected soil to new localities, the removal and transfer of root crops from infected gardens to new localities, and still another very important and unsuspected method is that of its possible transmission by manure from animals, which have been fed on uncooked potatoes infected with this disease. It will be seen, therefore, that the control measures which must necessarily be adopted in dealing with this pest are somewhat varied, and will require no inconsiderable attention to details, combined with the necessary legal power and authority.

It is proposed to quarantine the entire affected area, including the few outlying infections, from which quarantined area we will prohibit the removal of potatoes, root crops, manure and any materials which might carry the disease. Within the quarantined area certain "restricted" areas will be designated, within which the growing of potatoes will be prohibited. In order to further supervise the inspection for the disease in future years, it seems desirable to permit the growing of potatoes within the quarantined area only by license furnished from the Pennsylvania Department of Agriculture.

It is now contemplated that a laboratory for the more careful study of this disease will be established—probably at Freeland—and in addition to studies of the rapidity of dissemination, the life-history and etiology of the disease, certain experiments will be carried on, using steam sterilizing methods in an effort to kill the spores in the soil. This treatment, if successful, will be particularly valuable, even though somewhat expensive, in outlying infections where only small areas need treatment.

I wish to express my sincere thanks and appreciation for the assist-

ance furnished our survey by the men associated with the Bureau of Plant Industry, and workers in other states, who came to our assistance on very short notice. It is our purpose and desire to exert the utmost effort in every way possible to prevent the further spread of this most serious known potato disease, and considering the rather favorable conditions under which the disease occurs (in isolated villages without intervening cultivated territory) we have reason to believe that we can ultimately eradicate the pest. No expense and effort is too great, in consideration of the extremely dangerous and destructive nature of this long-lived soil-infecting plant disease, coupled with the fact that it is threatening the most important vegetable food crop in our United States.

AN EUROPEAN SCALE INSECT BECOMING A MENACE IN PENNSYLVANIA

By J. G. Sanders, *Economic Zoölogist, Harrisburg, Pa.*

It seems desirable to call the attention of our entomologists and horticultural inspectors to a scale insect, probably a native of China, later introduced to Europe, which in recent years has become established in Pennsylvania. This soft scale insect, *Lecanium prunastri* Fonsc., has been recorded a number of times from various places in Central Pennsylvania at rather widely scattered points, but principally from the south central and warmer section of the state.

Its principal host plants are peach, sweet cherry and apricot, and within the past two or three years this pest has become sufficiently abundant in a few localities to cause genuine damage and alarm to the fruit growers. Some branches of peach become so thickly covered with the scale, that they are badly dwarfed, and ultimately killed. However, in the orchards where the customary winter dormant spray with lime-sulfur wash is practiced, the scale has not assumed dangerous proportions.

In general appearance, in the summer season, it is not dissimilar from the common terrapin scale, although on closer inspection, it will be seen that the adult female scales are almost globular in form, and usually deep, chestnut red colored, usually closely massed on a tree when abundant. Not infrequently a large number of the small, glassy white male scales are associated with the larger round female scales. The accompanying figures will show some of the principal distinguishing characteristics of this scale, in comparison with our other common Lecaniums (Pl. 3, fig. 1.)

As far as records of the United States Bureau of Entomology indicate, the scale has never been reported except from the State of

Pennsylvania. Fortunately, it does not occur in close proximity to our larger fruit tree nurseries, hence has not become a nursery pest problem.

Records of *Lecanium prunastri* are at hand from the United States Bureau, which indicate its having been collected by F. N. Meyer in 1907, at several points in China, and also in Chili Province, China, in December, 1916. It was interesting to note that on a sample of plum from Dougsi, China, it was associated with *Diaspis pentagona*, the later species having also been found on various hosts quite commonly at several points in China. The writer can furnish a limited number of specimens of this scale to those desiring them, and will also gladly identify any material which is under suspicion as this species.

MR. T. B. SYMONS: I would like to ask if there is any attempt being made to grow different varieties in infested areas for immunity tests, as I understand that is the means of combating this disease in England.

MR. J. G. SANDERS: As I understand, they now have two or three varieties in England which are absolutely immune. It has been determined in conducting our laboratory experiments up there next year to test out all well-known varieties of potatoes we have in this country with a view to determining resistance and immunity. In the areas now infected we will absolutely prohibit the growing of potatoes with the idea of extermination of the disease.

I might say another word here, that the potatoes, after assuming that entire warty condition, quickly decay in the soil so that it impedes inspection work considerably if one is not on the ground at the proper time.

VICE-PRESIDENT E. C. COTTON: That would mean then the inspection would have to be made within three weeks after blooming.

MR. J. G. SANDERS: From that time on until digging is done. Our idea is to permit the growing of potatoes only by license; we shall have men on the ground to control it in that way.

MR. C. H. HADLEY, JR.: Do you find that disease is transmitted through storage?

MR. J. G. SANDERS: There are many points that I might mention about this disease that I could not bring out on account of lack of time. Potatoes affected by this disease cannot be held in storage, because they will quickly decay.

VICE-PRESIDENT E. C. COTTON: The spores from the decaying warts might attach themselves to sound potatoes and be a source of infection of soil in the field.

MR. J. G. SANDERS: Yes, and it would also be dangerous to transport the potatoes.

VICE-PRESIDENT E. C. COTTON: If there is no further discussion, we will take up, "The European Corn Borer Problem," by D. J. Caffery, Melrose Highlands, Mass.

THE EUROPEAN CORN BORER PROBLEM[1]

By D. J. CAFFREY, *Scientific Assistant, Cereal and Forage Insect Investigation, Bureau of Entomology, United States Department of Agriculture*

INTRODUCTORY

During the month of July, 1917, the presence of the European Corn Borer (*Pyrausta nubilalis* Hubn.) was discovered in the vicinity of Boston, Massachusetts by Mr. S. C. Vinal of the Massachusetts Agricultural Experiment Station. A report of this discovery, and of the preliminary investigation was published by Mr. Vinal in December, 1917[2]. At that time the insect was found to be present in an area of approximately 100 square miles immediately north and northeast of the city of Boston and was causing severe damage to sweet corn and other plants within that area.

The towns located at the mouth of the Mystic River were more generally infested than the others and from this it was inferred that the pest first became established in that vicinity. Considerable quantities of raw hemp are annually imported from Europe for use in the cordage factories located along the Mystic River. As hemp is one of the favorite food plants of the insect in Europe this may have been the medium through which the European Corn Borer was introduced into this country, although other plants may have acted as the carrier.

The seriousness of the situation caused by the presence of this insect and its potential menace to the corn crop of the entire country was early realized. The problem therefore became one of national importance and plans were made for a coöperative investigation of the subject during the season of 1918 by the Massachusetts Agricultural Experiment Station and the Bureau of Entomology, Division of Cereal and Forage Insects.

From the facts learned to date concerning the habits, food plants and distribution of the insect it is believed that the European Corn Borer is one of the most serious plant pests that has yet been introduced into the United States.

[1] Published by permission of the Secretary of Agriculture.

[2] Vinal, S. C., Mass. Agri. Experiment Sta., Bull. 178.

Serious Nature of this Imported Pest

Foreign History

Foreign literature records the fact that the species is widely distributed in Central and Southern Europe, West Central and Northern Asia, China and Japan. Corn, hemp, hops and millet are the principal economic plants attacked by the pest in the old world and a loss of 50 per cent of the crops frequently results from its depredations.

History in Massachusetts

Prior to 1917 the European Corn Borer had never been reported from the United States. During the period from its discovery in July, 1917, to November 30, 1918, the species was found to be present in thirty-four towns of Eastern Massachusetts comprising an area of about 320 square miles immediately west, north and northeast of the city of Boston. Adjacent areas in Massachusetts, Rhode Island, Connecticut, New Hampshire and Maine were examined for the presence of the insect, but with negative results.

Food Plants

The principal food plants of the species in Massachusetts were found to be sweet corn, field corn, fodder corn, celery, beans, potatoes, Swiss chard, beets, spinach, dahlias, gladiolus, chrysanthemums and several species of the larger weeds and grasses. Although corn is the favorite and preferred food plant, the great variety of other host plants has allowed the species to become established in almost every locality throughout the infested area. This greatly complicates the problem of controlling the pest in the area where it is now present and of preventing its further spread.

Habits and Life-History

The European Corn Borer passes the winter as full-grown, or nearly full-grown, larvæ within their tunnels in the host plant. They resume feeding with the advent of warm weather in April or May and pupate about the middle of May within their larval tunnels. The moths emerge about the first week of June and the females deposit their eggs, generally on the lower surface of the foliage of the host plant. The eggs are deposited in masses of from five to fifty eggs, individual females depositing an average of 350 eggs. The habits of the resulting larvæ vary according to the species of plant attacked. In the instance of corn the newly hatched larvæ feed first upon the epidermis of the leaf blades and then enter the stalk and tunnel through all parts of the plant except the fibrous roots. This results in a general weakening of the

plant which retards the development of the ear and in many cases prevents proper fertilization through injury to the tassel. The ears are also tunnelled by the larvæ which enter by way of the pedicel or bore directly through the husk and tunnel through the kernels and cob. As many as fifteen full-grown larvæ, each about an inch long, have been found feeding upon and within a single ear of sweet corn. This damage to the stalk and ears by the insect is often still further increased by the ingress of various rots which reduce both stalks and ears to a soft, putrid condition totally unfit for use as seed or for feeding to stock. Actual field counts in a quarter-acre plot of sweet corn have resulted in finding that 100 per cent of the ears were infested by larvæ of the European Corn Borer. Field counts made in badly infested areas showed an average of 46 larvæ per plant; or at the rate of about 1,050,000 per acre.

The larvæ of this generation reach full growth and pupate within their host plant about the middle of July. The moths emerge about the last week of July and deposit eggs for the second generation of larvæ on late corn or upon other wild or cultivated plants. The habits of these second generation larvæ in late corn are essentially the same as for the first generation except that greater injury is sustained by the ears. The larvæ feed until their activities are halted by the advent of severe winter weather in November or December.

It will be noted then that there are two complete generations of the European Corn Borer each year and that individual females in each generation deposit an average of from 350 to 550 eggs each. This enables the insect to increase its numbers very rapidly as its multiplication is practically unchecked by the activities of parasites or other natural enemies.

Danger of Widespread Injury to the Corn Crop

Although the female of the European Corn Borer is capable of flight and may gradually extend the limits of infestation by natural spread, the chief element of danger in this respect is that infested plants or plant products may be transported from the area now infested by the insect to points outside of that area.

Danger of Spread Through Transportation of Corn or Its Products

The transportation of corn or its products offers perhaps the most common means by which the insect may become widely disseminated.

Sweet Corn or Roasting Ears. During the early summer season considerable quantities of sweet corn are shipped north from the Boston wholesale market in order to take advantage of the early season prices prevailing in northern Massachusetts, New Hampshire and

Maine. Much of the sweet corn originates within the area infested by the European Corn Borer. An examination of the sweet corn exposed in the Boston wholesale market at this time revealed the fact that many of the ears and the attached portion of the pedicel contained larvæ and pupæ of the pest. Similar lots of corn had been sold to retailers through this same medium and distributed to consumers over a wide range of territory. Only a small per cent of the sweet corn exposed for sale was found to be infested and of this amount only a very small portion was shipped out of the infested area, but the danger existing from the possibility of the species being disseminated in this manner may be considered very great.

Cornstalks as Feed for Livestock. Another method of possible dissemination of the species is through the transportation of infested cornstalks. Many of the large market gardeners within the infested area sell their sweet corn fodder to owners of livestock after the ears have been harvested. Unless badly infested by the insect this fodder serves as a green and succulent feed which is greatly relished by livestock, especially dairy cows. Frequently this fodder is transported considerable distances by auto trucks and in several instances under observation infested material of this kind was taken to localities not previously infested by the insect.

Dry Cornstalks as Packing Material. Dry cornstalks are frequently used as rough packing material in the shipping of large articles of a fragile nature, and in this manner infested material may be carried for considerable distances. The over-wintering larvæ of the European Corn Borer are able to survive almost any extremes of cold, heat or drought within cornstalks, and are not inconvenienced by rough handling or being confined in a small space. They remain in a dormant condition within their host plant for a period of almost five months, from December until the following May, thus providing a long period of time during which they may be transported, with the consequent danger of their widespread dissemination.

Corn on the Cob. The larvæ of the European Corn Borer tunnel through the cobs of corn and frequently pass the winter in this situation. They are not at all inconvenienced by the drying out of corn stored on the cob, either for seed or for the feeding to livestock, and resume their feeding in the interior of the cob on the advent of warm weather in the spring.

Very little corn on the cob is shipped from the infested area but this means of possible dissemination must be considered.

Quarantine Measures Restricting Transportation of Infested Material. In order to prohibit the transportation of ma-

terial from corn plants infested by the European Corn Borer, Quarantine Order No. 36 was issued by the Federal Horticultural Board and became effective October 1, 1918.

This quarantine prohibits interstate movements of all corn fodder, or corn stalks, whether used for packing or otherwise; green sweet corn; roasting ears; corn on the cob; and corn cobs from the towns within the area infested by the European Corn Borer.

The State of Massachusetts is now preparing to institute a similar quarantine which will prohibit the intrastate movements of such infested material.

Danger of Spread through Transportation of Infested Material Other than Corn and Corn Products

If corn were the only plant attacked by the European Corn Borer the problem of restricting the spread of the insect would be comparatively simple; but several of the other host plants present additional openings by which the pest may be transported through the ordinary avenues of trade.

In badly infested areas the larger larvæ of the European Corn Borer frequently leave their original host, whether it be corn or some of the weeds or grasses, and enter other plants growing in the vicinity. This change of habitat is generally due to the fact that the food supply in the original host has been exhausted. Under these circumstances the larvæ may attack and enter almost any plant growing in the vicinity and possessing a moderately soft and succulent stem.

In home gardens, and in market garden areas it is a common practice to grow several crops close together, or inter-rowed in the same area. Sweet corn is almost always included among these crops and serves to attract the ovipositing females of the European Corn Borer. After the food supply in the corn plants has been exhausted the larvæ enter the other plants. In this manner the larvæ frequently infest celery, Swiss chard, spinach, beans, beets, potatoes, tomatoes, and some of the flowering plants including dahlias, gladiolus and chrysanthemums.

Celery

The outer stalks of celery are tunneled by the larvæ. As many as eight full-grown specimens were taken from a single stalk. During the process of harvesting celery most of these outer stalks are commonly removed and discarded. Stalks infested by the European Corn Borer are especially noticeable owing to their wilted appearance, but it is very possible that recently infested stalks may be overlooked by the ordinary workman and the insect transported to new localities through this medium.

Swiss Chard

The stalk and midrib of the leaf of Swiss chard are commonly tunneled by the larvæ. The injured leaves are very noticeable and are ordinarily discarded in preparing the crop for market. There is a possibility, however, that recently infested leaves may pass inspection and transport the pest to new areas.

Beans

The vines, immature seed and green pods of beans are tunneled by the larvæ of the European Corn Borer. The principal source of danger from the pest attacking this crop consists of the possibility that "string beans" containing larvæ of the species may be shipped to points outside the infested area.

Beets and Spinach

The tops of beets and spinach, or that portion of the plants commonly sold for greens, are sometimes infested by the pest. The larvæ tunnel in the stem and midrib of the leaf and frequently their injury is of such a nature that it may be overlooked by the workmen handling the crop, with the consequent danger of infested material being shipped to localities not previously infested by the insect.

Potatoes and Tomatoes

The vines of potatoes and tomatoes are frequently tunneled by the larvæ of the European Corn Borer but ordinarily this is not a source of danger in the possible dissemination of the species.

Dahlias, Gladiolus and Chrysanthemums

The stalks and flower stems of Dahlias, Gladiolus and Chrysanthemums are frequently entered and tunneled by larvæ of the European Corn Borer. The injury to these plants is of such a nature that infested stems generally wilt and break at the point where the larva enters; but large stalks or stalks recently infested do not show any conspicuous external indications of infestation and under certain circumstances may be included in shipments of these plants to points outside the infested area.

Methods Adopted for the Control of the Insect and its Limitation to the Area now Infested

It is evident that any measures looking toward the control of the European Corn Borer and its limitation to the area now occupied must consist of the destruction of the infested plants within that area, sup-

plemented by quarantine measures to prevent the dissemination of the species through the transportation of infested material.

These measures are now being applied to the solution of the problem and it is hoped that by their careful and intensive application the pest may be prevented from reaching the corn belt of the country and causing widespread injury to our most valuable crop.

VICE-PRESIDENT E. C. COTTON: Has anyone any questions to ask? We have just a short time which we can devote to discussion.

MR. C. H. HADLEY, JR: To what extent can this pest be handled if it were to spread over the entire country?

MR. D. J. CAFFREY: The damage could be reduced by applying very strict clean-up methods, that would include all corn and weeds and grasses within the infested area. An ordinary farmer would need to destroy his old cornstalks in the same manner, get his neighbors to do the same, and give the waste areas a pretty thorough cleaning up.

MR. W. E. BRITTON: I would like to ask about the expense of that treatment.

MR. D. J. CAFFREY: That would vary in the different sections. I should think possibly about ten dollars an acre. This would include treating weed areas.

MR. W. E. BRITTON: That would be rather a large percentage on the cost of the growing corn.

MR. D. J. CAFFREY: Yes, it would be, and it would not necessarily be entirely effective either.

MR. W. C. O'KANE: I should question whether, with our present knowledg , it can be economically controlled as a field proposition.

MR. D. J. CAFFREY: It is only under certain circumstances that the damage could be greatly prevented. As I pointed out from the first this illustrates the serious nature of the insect.

MR. W. W. CHASE: How do you spend the money in that way?

MR. D. J. CAFFREY: Generally we spend most of the money for labor. Take a large weed area for instance; in the spring when dried, weeds can be handled easily. You understand the entire plant must be destroyed. Of course that would be rather difficult during the fall when the plants are green, but in the spring the cost is considerably reduced because we can cover a larger area with a smaller force of men.

MR. E. P. FELT: I would like to ask what are the possibilities of exterminating such a pest as this? Would it be economically practicable?

MR. D. J. CAFFREY: I think I can answer that question better perhaps two or three years from now.

MR. E. P. FELT: The time to answer it is now.

MR. D. J. CAFFREY: That is a pretty hard question to answer at the present time. If we could reduce the entire area that is infested by the insect to a desert and absolutely destroy plant life, we could probably exterminate it in a short time.

MR. W. C. O'KANE: Is it necessary to reduce the entire area to a desert?

MR. D. J. CAFFREY: Perhaps that statement should be amended to include the plants infested by the insects.

MR. G. A. DEAN: What are you going to do when an insect like this becomes established in a state or states like Illinois, Ohio, Indiana, Iowa, Nebraska, and Kansas, where they really have some corn fields? For instance, a man does not think he has a corn field unless he has more than forty acres. In Kansas at the present time there are over ten million acres of winter wheat. I should like to ask Mr. Walton whether he thinks it is possible to stamp out the infestation in Massachusetts, providing sufficient funds are available. Even though it should cost ten million dollars, what would that be compared with the injury or loss if this insect becomes established in the great agricultural states, where they grow corn, wheat, oats, and the kafirs?

MR. W. B. WALTON: From what we know regarding the control of this insect at the present time, I must confess that I am very skeptical respecting the possibility of exterminating it. I don't believe it can be done, but I am "willing to be shown."

SECRETARY A. F. BURGESS: Is it worth trying?

MR. W. R. WALTON: Yes, of course, it is worth trying, when we learn how to do it. I don't think we are ready yet. The insect hasn't spread very much during the past year. We are now conducting experimental control work, and we know a good bit of its life-history. We don't know very much about the methods of controlling it. I should like to ask Mr. Caffrey to tell us something about the success of this work so far as it has been carried.

MR. D. J. CAFFREY: The control work as far as it has been carried shows that where we can get into an area where the plants are dry and start a good hot fire, we can absolutely destroy all parts of the plants. But in corn fields or weed areas where there are large weeds, more or less green, it is very difficult to destroy the larvæ.

MR. W. C. O'KANE: How about pulling up the plants and burning them?

MR. D. J. CAFFREY: That was tried, the plants were placed in piles and we attempted to burn them with oil. When dry enough, they burn readily, but if they are very green it creates only a smudge, and we find a certain number of living larvæ left. Then we tried a large kerosene

torch, and that made pretty fair headway, when the vegetation was dry enough. In areas where there were large weeds and other large stems it became almost an impossibility to make any headway with that type of apparatus.

MR. W. H. GOODWIN: In my tests last summer with oils, I found that I could not use kerosene alone, but I could use kerosene in combination with a cheap lubricating oil known as a black oil. I found that in order to get rid of weeds and plants I had to almost thoroughly saturate the ground at the surface, and it must be nearly dry. When this mass of oiled vegetation was set afire even two or three days after spraying it burned to the ground. Now one of the problems with the Japanese beetles is to clean out those waste places. It looks to me as if this phase of the problem would apply to a certain extent to this corn borer, by getting rid of all waste places as far as possible in the area infested.

MR. W. C. O'KANE: In order to complete my information I would like to know the total area infested this year and last year.

MR. D. J. CAFFREY: I can answer that question by saying that the original survey in 1917 was made by one man; who attempted to find out during his spare time the outside limits of the infestation and at that time he found that about a hundred square miles were infested. This was during the fall of 1917, right after the insect was discovered.

Now, last season we made a very careful survey during the spring, summer and fall, and found that all together about three hundred and twenty square miles were infested. That is quite an increase over the area that we found infested at first, but I am not satisfied that the hundred square miles was really the outside limit of infestation at that time. As I said, there wasn't time to make the original survey very thorough.

MR. W. C. O'KANE: Have you data for saying that the insect has not spread very much during this past year?

MR. D. J. CAFFREY: We have in part of the area at least. I am referring to the limits south and west of Boston, where in some places it has spread only from a half to three quarters of a mile.

In many of the towns in the north that add greatly to the area infested we found only very few specimens after making a most exhaustive search.

MR. W. R. WALTON: In other words you are satisfied that the preliminary survey was very incomplete.

MR. D. J. CAFFREY: Yes, necessarily so, because there was very little time spent on it. I think Mr. Walton's statement that the spread of the insect has been comparatively slow is well founded. I might mention another case of a market gardener in West Medford who was a very observing man, an up-to-date grower in every respect, and he

claims that he has been severely injured by the pest in the last two or three years. If that is so, there must have been a considerable number of larvæ present during that time, and they must have gained entrance to his fields quite a few years previous to that. The outside limits extend about four miles beyond his farm now.

PRESIDENT E. D. BALL: It seems to me that if this insect is anywhere nearly as important as it has been represented to be, that even a minute of delay, to say nothing of a year, is serious, very serious, that while it may be spreading but a few miles a year, it has already spread over several hundred square miles and may spread in one big jump at any time, into the heart of the corn area.

We have several records of waiting too long before starting. The gipsy moth and the boll-weevil are good examples of this kind of folly. Here is a chance for the entomological fraternity to assert itself and with one voice, say that we are going after this insect and that we are going after it now. Suppose we fail—it is nothing. If we attack four insects and fail on three, but win on the fourth, we have won tremendously.

Corn is the biggest crop in America, and I think that the corn growers of the Mississippi Valley have a right to demand protection from this pest, and that every possible source of protection should be used at once. We have learned in this last year what it means to go into a thing and do it—not to wait and talk about it and say that it is impossible, but to do it. It seems to me that that should be our slogan today; let us go in and do it.

SECRETARY A. F. BURGESS: I want to say one word in regard to spread. The corn borer is in the same region where the gipsy moth was originally introduced. The gipsy moth was introduced in 1868 or 1869, and it did not become a pest in the region where it was introduced until about 1890. During the time from 1890 to 1900, when work was carried on by the state of Massachusetts to clean out the gipsy moth, the largest area that it occupied was approximately the area that the corn borer occupies at the time. We did not know at that time—and we have only known for a few years—the principal method of spread of the gypsy moth.

The female moth does not fly; the principal method of spread is by the small caterpillars being blown by the wind immediately after hatching. The trend of spread is toward the north or northeast, but it took the gipsy moth, even with the small caterpillars being capable of blowing twenty miles, approximately twenty-five years to occupy the territory that is now occupied by the corn borer. If the statements made are correct in regard to the time of introduction, in all probability the corn borer has not been in this country more than five or six years.

I simply mention this to show that there may be more possibility of rapid spread of the corn borer than we think at present.

Another factor in connection with the spread is this: When you get a large area heavily infested the spread will be much more rapid than when the area is small even if it is well infested. These are factors in the problem that should be considered.

MR. R. K. BEATTIE: There is a parallel in the White Pine Blister Rust that I wish to call to your attention. For four or five years the Office of Forest Pathology of the Bureau of Plant Industry tried to get people interested in the eradication of the White Pine Blister Rust. At that time its area of distribution in the United States was small. Because the disease was spreading slowly, people ignored it and no one could be interested in combating it. Suddenly it became epidemic. In two years it had spread so rapidly that the cleaning up of the White Pine forests of New England was impossible. Before that epidemic, anyone would have said that New England could be cleaned up. Now, such an effort is made only in isolated localities. I cannot say that there is necessarily parallelism between plant diseases and insects, but in both groups we do have epidemics. We have had entirely too many cases in this country among plant diseases where we have tried to find out scientifically all about the disease before we began to fight it. When citrus canker first appeared in the United States some pathologists believed its study should be completed before the work of combating it began. But the fight was really begun on this disease while it was still thought to be caused by a fungus. Later, its bacterial cause was discovered after the campaign of eradication was well under way. Happily in this case the campaign has been very successful and the disease has been almost completely eradicated. If they had waited until they found out all about it we would never have gotten rid of citrus canker.

MR. W. H. GOODWIN: Naturally I am interested in the Japanese beetle, that has been established practically for eight years, and I believe it is a good time to wipe it out while we have a chance. We must stamp it out or it will get away, and it has got to be handled sufficiently rough to get rid of it in the next two or three seasons.

MR. W. C. O'KANE: I would like to have the permission of the association to propose the following motion: That this association endorse the utmost possible measure of eradication of the European corn borer, and further endorse the proposition of asking Congress for sufficient appropriation to undertake immediately a competent campaign of eradication under Federal direction. Motion seconded.

MR. E. P. FELT: I want to go on record as representing an adjacent state, in favor of going to the limit.

MR. H. A. REYNOLDS: I want to say for the American Plant Pest Committee, which is an outgrowth of the Committee on the Suppression of the Pine Blister Rust, that we have held a meeting of all the state agricultural commissioners and state entomologists in New England, and it was unanimously agreed that we should try extermination. Nobody knows whether we can exterminate this pest or not, but we feel that with a three billion dollar crop at stake, we can afford to spend five hundred thousand to a million dollars a year eternally to keep it confined to Massachusetts.

Mr. Beattie brought up a very interesting proposition which appeals to me. He said that the government tried to get the fellows out in the states interested in the blister rust for years, and I know that is true, but now it seems in this case the situation is reversed. We feel that the department at Washington wants to put in only twenty-five to thirty thousand dollars, as they have told us, for investigation. I have the highest respect for investigators, but since we know one way of dealing with the pest, it seems to us in New England that we ought to go ahead and kill all of them we can during the time we are making the investigation, and it has been proposed that we ask for an appropriation of five hundred thousand dollars for that work, this coming year. We were to have a conference here today. Dr. Marlatt, I understand, is not able to appear. I do hope that this organization will go on record to back up the American Plant Pest Committee in this proposition.

MR. W. E. BRITTON: Mr. Burgess might have told us more about the experience in Massachusetts of fighting the gipsy moth and how the state kept up the work for ten years and then stopped for five, and he might have told you the number of hundreds and thousands of square miles that the insect occupied when they took up the work again in 1905 or 1906.

I had the privilege of visiting Massachusetts in September last, and looking at some of the infested corn in the vicinity and just west of Boston. In my opinion, this is one of the most dangerous insects which has ever been introduced into this country, and I believe it is twenty-five times more dangerous than the pine blister rust ever was, or ever will be. It is a question whether it can ever be exterminated, but we never know whether we can do anything until we try. It is certain that if it ever can be exterminated, it can be done now much easier than it can be five or ten years from now.

I am in favor of a large appropriation, and of making a strenuous attempt to exterminate that insect, and I expect that we can at least hold it where it is for a long time. Of course, if we fail, that is a thing which we may do in any attempt which we may make, but I believe it is

certainly worth while, and if we do not make an attempt we will be criticized years later because we did not make it. I am in favor of a large appropriation, made as soon as we can get it.

MR. G. A. DEAN: It seems to me that this is the very thing to do. In my mind, we have never had a better opportunity to get the entomologists all over the country working together like the parts of a machine.

Last evening, in fact, all through these meetings we have been saying we will never get anything unless we go after it. Now, here certainly is an opportunity to go after something. I would rather fail a half dozen times than have it said I never tried. Speaking now for Kansas, I feel that if we want to get our senators and representatives in Congress interested in insect control, just bring to their attention, and convince them that an insect is threatening the corn, wheat, oats, and kafir crops. This at once touches powerful constituents, the farmer and the stockman. With the splendid organization that many of the entomologists have through the county farm bureaus, and the extension divisions, they can now put things across that were not possible a few years ago. A state institution with a farm bureau in nearly every county, with a membership including practically all the leading farmers and stockmen, can bring a powerful influence to bear on their congressmen and get almost any reasonable thing they desire.

Mr. T. H. PARKS: It seems to me we should not consider the money lost if the attempt to eradicate this insect in Massachusetts is not successful. The work will, of necessity, show how to control the insect in small areas. If it is delayed a few years in getting into the corn belt, the money will be well spent.

MR. P. J. PARROTT: My confidence in the work of quarantine inspection was greatly increased by the efficient efforts of the federal and state authorities in wiping out the gipsy moth in Geneva. I had no idea when they undertook this work that they could ever clean up Geneva and prevent the dissemination of the insect in Geneva and outlying counties. I heartily endorse the sentiments that have been expressed, as I believe we are confronted with a serious problem that demands concerted action by the state and national authorities. We have had in the past many failures in efforts of this character because work was started too late. Now that we have state and federal organizations that are well equipped for the undertaking, I hope very much that they secure adequate funds and that the attempt be made to restrict this insect to the present area and if possible exterminate it.

SECRETARY A. F. BURGESS: Professor Parrott spoke about the extermination of the gipsy moth at Geneva. That was done because we had the organization and money to do it; the same is true of colonies

at Cleveland, Ohio, Rutherford, N. J., Mt. Kisco, N. Y., Wallingford, Conn., and in the Berkshires in Massachusetts. It has not been done in the big area because there is not the money to do it at the present time.

By vote of the association the motion was carried.

Adjournment.

(Papers read by title.)

BIOLOGICAL NOTES ON SOME FLATHEADED BARKBORERS OF THE GENUS MELANOPHILA

By H. E. Burke, *Specialist in Forest Entomology, Forest Insect Investigations, Bureau of Entomology, United States Department of Agriculture*

Among the flatheaded barkborers most destructive to forest trees are several species of the genus Melanophila. One species, *M. drummondi*, is of particular interest at the present time because it attacks the sitka spruce which is so necessary in the manufacture of aeroplanes. This and other species, *M. gentilis*, *M. fulvoguttata* and *M. californica*, attack and kill some of our most important coniferous forest trees. Many sugar pine, yellow pine, douglas spruce, true firs, true spruces, hemlocks and larches in American forests have been killed at various times past and are now being killed by these pernicious pests. Even should an attack not kill the tree the injury made often causes checks, "gum spots" or other defects to form in the wood which reduces its value for timber.

A curious injury to sugar pine and yellow pine timber in northern California consists of a brown, pitchy, irregular scar several inches in diameter from which radiates small, winding, pitchy lines. The forest pathologists consider the central scars to be caused by a light or diffused stroke of lightning which slightly separates the bark and wood. The radiating lines are the mines of Melanophila larvæ whose mothers were attracted to the scars to lay their eggs. When the attack failed the larvæ died and the new growth covered the wound, forming the curious defect.

Dr. A. D. Hopkins has published notes on the injuries caused by several species of Melanophila in bulletins 32 and 56 of the West Virginia Agricultural Experiment Station and 21, 37, 48 and 53 of the Bureau of Entomology. The writer has mentioned them in the United States Department of Agriculture Yearbook for 1909 and in papers in the Journal of Economic Entomology for June, 1917, and April, 1918. Many other observations have been made from time to time by various members of the Branch of Forest Insect Investigations. The present paper is a summary of the data obtained from all of the above notes.

As a general thing the species of the genus Melanophila have one generation a year. Beetles emerging from the trees in the spring and summer of one year lay eggs which hatch into larvæ that live over the winter and pupate and transform to beetles that emerge the spring and summer of the next year. Sometimes, however, part of the larvæ of one generation will remain in the pupal cells for several years before pupating and transforming to beetles. On June 13, 1915, Mr. F. B. Herbert collected at Placerville, California, some *M. gentilis* prepupal larvæ which held over until March 24, 1917, before pupating and transforming. This would be about three years in the larval stage. Frequently some larvæ are found in trees from which the main brood has emerged a year or more.

All of the species studied in the United States are barkborers. The larvæ mine in the inner bark and outer wood and pupate in cells in either the bark or wood. The eggs are laid in the crevices of the bark between the scales. The beetles usually feed on the bark or foliage of the host trees but Ricksecker mentions (*Entomologica Americana*, 1885) having seen adult *M. consputa* devouring scorched termites.

Except in one instance where the writer reared a specimen of *M. acuminata* from the monterey cypress (Cupressaceæ) all of the American species of Melanophila appear to confine themselves to host plants of the family Pinaceæ.

The larval characters indicate that the genus should be divided into two. The true Melanophila type of larva such as occurs in *acuminata*, *consputa*, *gentilis*, *drummondi*, *fulvoguttata*, *californica* and *piniedulis* has characters which make it generically distinct from the *intrusa* larva. In the first case the rugose areas on the plates of the first thoracic segment are broad while in the larva of *intrusa* and *aeneola* they form narrow borders along the grooves of the plates.

At the present time the only method of fighting these insects in the forests is to control them by burning the infested wood and bark before the adults emerge and attack new trees. Parasites and predators commonly attack them, however, and as our knowledge of these increases, and improved methods of forestry are put into practice, Melanophila depredations should be prevented before they have to be controlled.

Melanophila miranda Lec.—Leconte gives Fort Union, New Mexico, as the type locality. Horn says that it occurs from Oregon to Texas in the mountain regions. Considerable collecting has been done in the forested areas of these regions by members of the Branch of Forest Insect Investigations but no specimens have been taken. The species is thus extremely rare or it does not infest the common forest trees.

Melanophila notata Lap. and Gory—Middle and Southern States is the range given by Leconte, Horn says Georgia and Florida and Blatchley adds Marion County, Indiana. So far we have made no records on this species.

Melanophila acuminata De Geer—Appears to be same as *longipes* Say and *atropurpurea* Say; Wisconsin, South Dakota, Colorado, Idaho, Washington and California; mines inner bark and outer wood of injured, dying and dead trees; pupates in wood; red or Norway pine (*Pinus resinosa*), lodgepole pine (*P. murrayana*), monterey cypress (*Cupressus macrocarpa*); taken on the bark of yellow pine (*Pinus ponderosa*), engelmann spruce (*Picea engelmanni*), sitka spruce (*P. sitchensis*), lowland fir (*Abies grandis*), giant arborvitæ (*Thuja plicata*); flies from May to October; pupates during spring and summer; adults common in smoke of forest fires; prefers to attack trees scorched by fire.

Melanophila consputa Lec.—Northern to central California; mines inner bark and outer wood of injured, dying and dead trees; pupates in either bark or wood; yellow pine (*Pinus ponderosa*), lodgepole pine (*P. murrayana*), monterey pine (*P. radiata*), knobcone pine (*P. attenuata*); pupates during spring and summer; flies from April to October; common during late summer around burned areas; prefers to attack trees scorched by fire; sometimes annoys workmen around sawmills and smelters by alighting on them and pinching the hands or face with its mandibles.

Melanophila gentilis Lec.—South Dakota, Colorado, New Mexico, Montana, Utah, Arizona, Idaho, Oregon, California; mines inner bark and outer wood of normal, injured, dying and dead trees; pupates in bark or outer wood; sugar pine (*Pinus lambertiana*), yellow pine (*P. ponderosa*), rock pine (*P. scopulorum*), jeffrey pine (*P. jeffreyi*); flies from March to August; pupates from March to July; attacks and kills small and large trees; very injurious to second growth in some localities; is one of the most injurious enemies of its host plants.

Melanophila drummondi Kirby—Montana, Colorado, New Mexico, Idaho, Utah, Arizona, Washington, Oregon, California; mines inner bark and outer wood of normal, injured, dying and dead trees; pupates in bark or wood; western larch (*Larix occidentalis*), engelmann spruce (*Picea engelmanni*), sitka spruce (*P. sitchensis*), western hemlock (*Tsuga heterophylla*), alpine hemlock (*T. mertensiana*), douglas spruce (*Pseudotsuga taxifolia*), alpine fir (*Abies lasiocarpa*), lowland fir (*A. grandis*), white fir (*A. concolor*), lovely fir (*A. amabilis*), noble fir (*A. nobilis*), red fir (*A. magnifica*); flies from May to September; pupates from February to June; attacks and kills many trees; causes defects to form in the wood of others which it attacks but fails to kill.

Melanophila fulvoguttata Harris.—Maine, New Hampshire, Michigan, West Virginia, North Carolina; mines inner bark and outer wood of normal, injured, dying and dead trees; usually pupates in the bark; spruce (*Picea* sp.), red spruce (*P. rubens*), hemlock (*Tsuga canadensis*); flies from May to August; pupates from April to July; attacks and kills many trees and seriously injures others; is the most destructive enemy of the eastern hemlock as has been pointed out by Dr. Hopkins in Bulletin 37 of the Bureau of Entomology.

Melanophila californica Van Dyke—Idaho, Oregon, California; mines inner bark and outer wood of normal, injured, dying and dead trees; pupates in bark and wood; yellow pine (*Pinus ponderosa*), jeffrey pine (*d. jeffreyi*), digger pine (*P. sabiniana*), coulter pine (*P. coulteri*), monterey pine (*d. radiata*) knobcone pine (*P. attenuata*); flies from May to August; pupates from March to July; attacks and kills many second growth trees and assists barkbeetles to kill others.

Melanophila pini-edulis Burke—Colorado, Utah, Arizona; mines inner bark and outer wood of normal, injured, dying and dead trees; pupates in outer wood; pinon (*Pinus edulis*); flies from June to September; pupates from June to July; assists barkborers and barkbeetles to attack and kill trees.

Melanophila intrusa Horn—Colorado, California; mines inner bark and outer wood of injured, dying and dead trees; pupates in outer wood; sugar pine (*Pinus lambertiana*), yellow pine (*P. ponderosa*), rock pine (*P. scopulorum*), knobcone pine (*P. attenuata*); flies from June to July; pupates from March to June; usually lives in the suppressed limbs of living trees but sometimes attacks saplings, especially those over-topped by larger trees.

Melanophila æneola Melsh.—West Virginia, North Carolina; mines inner bark and outer wood of dying and dead trees; pupates in the wood; scrub pine (*Pinus virginiana*), pine (*Pinus* sp.); flies from April to August; infests overtopped branches and trees.

Melanophila obtusa Horn—One specimen from Georgia recorded by Horn in his revision of the genus. No specimens have been collected by us.

THE LIFE-CYCLE OF LACHNOSTERNA LANCEOLATA SAY[1]

By WILLIAM P. HAYES, *Assistant Entomologist, Kansas State Agricultural Experiment Station*

INTRODUCTION

Because of the growing importance of *Lachnosterna lanceolata* Say as a pest of growing wheat in Kansas and Oklahoma, the life-history study herein reported was taken up as a part of the Kansas Experiment Station project "Insects Injurious to the Roots of Staple Crops." This project aims ultimately to work out the life-histories of all other Kansas species of *Lachnosterna* and related genera as well as wireworms and other underground pests of staple crops growing in the state. The work is being carried out under the immediate direction of Mr. J. W. McColloch, to whom thanks are due for his kindly aid and criticism.

HISTORY AND IMPORTANCE

Lachnosterna lanceolata Say, an important enemy of growing wheat in Kansas and Oklahoma, was originally described as *Melolontha lanceolata* Say (1824, p. 242), from specimens collected near the Rocky Mountains. The remark being added that it inhabits Missouri and "Arkansa." Since then it has been placed in three other genera—*Tostegoptera*, *Lachnosterna*, and *Phyllophaga*.

This insect is destructive both in the larval and adult stages. Cockerell (1895, p. 69) first reported adults injuring growing cobs of corn in New Mexico. Howard (1900, p. 107) reported the adults attacking collards in Texas, and stated that they had been "noticed more or less since 1890. Their principal food was stated to be 'careless weed' (Amaranthus), two or three species of which grow commonly in or near cornfields." Sanderson (1904, p. 95) stated that the beetle often occurs in large swarms and eats off young cotton plants on considerable areas. In 1905 (p. 13) he again mentions the injury to young cotton, as well as "various other crops, especially garden truck, in the arable land west of the ninety-seventh meridian." It is regarded as most injurious in west central Texas. The wild sunflower (*Helianthus*) is added as a food plant. The same writer (1906, p. 18) attempted to rear the species and succeeded in hatching four eggs. The resulting larvæ fed on cotton and grass roots during the summer and fall. This apparently comprised the total of our knowledge of the

[1] Contribution from the Entomological Laboratory, Kansas State Agricultural College, No. 35. This paper embodies the results of some of the investigations undertaken by the author in the prosecution of project No. 100 of the Kansas Agricultural Experiment Station.

habits of this insect until the appearance of the notable work on the life-histories of *Lachnosterna* by Davis. This writer (1916, p. 276) successfully reared one specimen to the adult stage in two years, but the length of the various stages were not noted. He also writes of the grubs as injuring wheat in Kansas.

During the past few years the grubs of this species have come into prominence every fall soon after wheat planting time in southern Kansas and northern Oklahoma where they annually damage thousands of acres of young winter wheat. During the past fall their damage has been especially severe in southern Kansas. In the fields they often work in small patches which enlarge the following year. Grubs of various sizes are to be found in the fields and are frequently so abundant that a single handful of soil will contain three or four grubs. In other parts of the state the grubs and beetles are found abundantly in the native grasslands and are often a serious pest of pasture grasses. One instance was noted where the beetles were found feeding on growing oats.

Distribution

Lachnosterna lanceolata is practically confined to the region bounded on the west by the Rocky Mountains, and on the east by the Mississippi River. Specimens have been reported as taken in South Dakota, Nebraska, Colorado, Kansas, Missouri, New Mexico, Oklahoma, Arkansas, and Texas. Forbes (1894, p. 139) lists the species as rare in central and southern Illinois. This was the only record found of its occurrence east of the Mississippi River.

The spread of this species is naturally slow. The females are wingless and cannot travel far. One specimen was once observed being carried by high water in a small stream. Local distribution in Kansas varies markedly in the northern and southern parts of the state. In the northern part of the state the species is, with rare exceptions, confined to the higher upland fields and pastures, while in southern Kansas the adults and grubs are found in the lower wheat lands of that region.

Life-Cycle

Egg.—The eggs of this species are laid singly or in small groups of three or four in clumps of soil, preferably undisturbed or covered with vegetation, at depths ranging from 1 to 7 inches. The eggs are white in color and when freshly laid are oval in shape, about 2 mm. long, but in the course of a few days they assume a globular shape and increase slightly in size, becoming about 2.8 mm. in diameter. The length of the egg stage was found to vary from 9 to 29 days with an average of 16 days. Table I shows the maximum, minimum and average length of the egg stage obtained in three seasons.

TABLE I—SHOWING LENGTH OF THE EGG STAGE

Year	No. to Hatch	Maximum Length of Stage, Days	Minimum Length of Stage, Days	Average Length of Stage, Days
1916	630	19	10	14.1
1917	93	29	10	17.1
1918	813	22	9	16.4
General average				16.0

Oviposition begins the latter part of June and extends into the first weeks of August. The earliest eggs laid under artificial conditions were found in cages June 25 and the last eggs August 9. The exact number of eggs laid by single individuals has not been determined. One isolated female laid nine eggs and another laid fifteen. This number is undoubtedly below the average. A few days before hatching the young larva can be seen through the shell of the egg.

LARVA.—The newly hatched larva is about 2 or 3 mm. long, pure white in color, with a white head which rapidly turns to a light brownish color. Soon after feeding begins, a black meconium appears at the posterior end of the alimentary tract. These grubs grow much slower than other two-year grubs of the genus *Lachnosterna* and at the end of the first growing season are much smaller. There is this difference, however: the *lanceolata* grubs pupate in the spring and must live through two winters, whereas other so-called two-year grubs pupate in the fall after having passed through only one winter.

When full grown the grubs shed the meconium of the alimentary tract and pass through a quiescent or semi-pupal stage. Almost two full years are required for the grubs to reach maturity. Table II shows the length of the larval and semi-pupal stages as worked out at Manhattan, Kansas.

TABLE II—LENGTH OF THE LARVAL, SEMI-PUPAL, AND PUPAL STAGES

Rearing Number	Date Hatched	Date Became Semi-Pupa	Date Pupated	Date Became Adult	Length of Larval Stage: Months	Days	Length of Semi-Pupal Stage, Days	Length of Pupal Stage, Days	Sex
1694	7-16-16	6- 1-18	6- 8-18	6-24-18	22	15	7	16	♀
1776	7-16-16	5-27-18	6- 4-18	6-21-18	22	11	7	17	♀
1777	7-16-16	5-31-18			22	14			
1870	7-17-16	6- 1-18	6-10-18	6-24-18	22	14	9	16	♂
2157	7-20-16	6- 1-18	6-10-18	6-25-18	22	12	9	15	♂
2530	7-24-16	5-27-18	6- 7-18	6-24-18	22	3	11	17	♀
2614	7-24-16	6- 3-18	6-10-18	6-25-18	22	10	7	15	♂
2713	7-23-16	5-31-18	6-10-18	6-25-18	22	8	10	15	♂
2819	8- 1-16	6-12-18	6-17-18	7- 1-18	22	11	5	14	♂

The maximum length of the larval stage, as shown by Table II, was 22 months and 15 days, and the minimum was 22 months and 3 days. The semi-pupal stage varied from 5 to 11 days.

The first larvæ begin hatching during the first and second weeks of July and continue until the latter part of August. The earliest egg to hatch in life-history cages was July 8, and the last August 28.

The grubs were reared to maturity on germinating wheat grains in ordinary salve boxes. The mortality was high. Over 700 boxes, each with a single grub, were started in 1916. Of these only 9 reached the semi-pupal stage, and 8 the pupal stage. A few 1916 grubs lived until September 1, 1918, indicating a possible three-year life-cycle in some cases.

The possibility of a three-year life-cycle is also indicated by observations made in Harper County, Kansas, during the fall of 1918. In the northern part of the county three distinct sizes of grubs were found in almost equal numbers in nearly all infested fields. In the southern part of the country only two sizes—first year and full grown—were found.

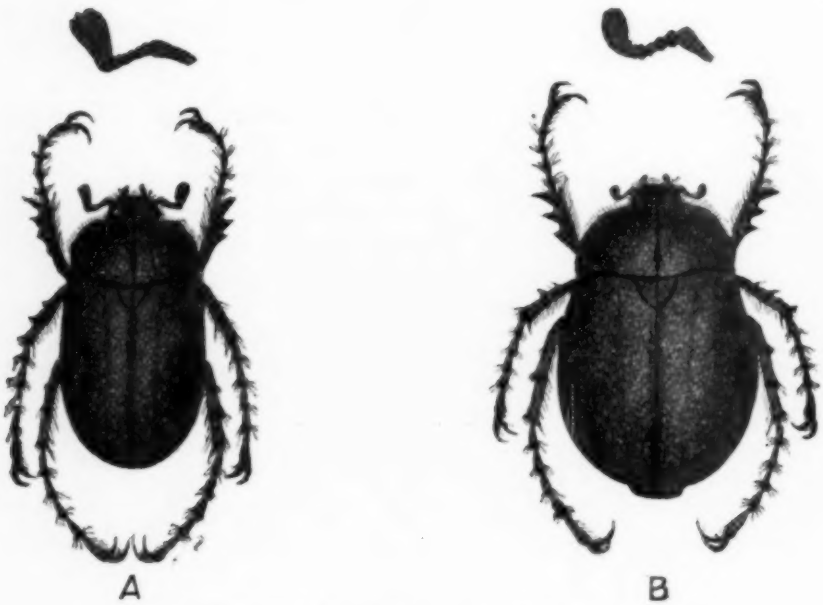


Fig. 5. *Lachnosterna lanceolata* adults: *A*—Male; *B*—Female.

PUPA.—The pupa resembles any other pupa of the genus *Lachnosterna*. It is about 18 mm. long and 9 mm. wide. When freshly transformed it is pure white in color. It gradually darkens until just before emergence the color of the adult appears through the pupal skin in many places. Table III shows the length of the pupal stage of sixteen individuals collected as grubs at various times.

TABLE III—SHOWING LENGTH OF THE PUPAL STAGE

Rearing Number	Date Pupated	Date Became Adult	Sex	Length of Pupal Stage, Days
2061	6-12-16	6-30-16	♂	18
2943	7-12-17	7-28-17	♂	16
2964	6-16-17	7- 6-17	♀	20
3106	7-27-17	8- 8-17	♀	11
3107	7-16-17	7-24-17	♀	8
3108	6-22-17	7-11-17	♀	19
6	7-18-16	7-27-16	♂	9
3021	6-11-18	6-24-18	♀	13
3022	6-27-18	7-10-18	♀	13
3024	6- 7-18	6-21-18	♀	14
3027	6- 7-18	6-22-18	♂	15
3030	6-10-18	6-24-18	♀	14
3043	6-14-18	6-26-18	♀	12
3081	6-20-18	7- 2-18	♀	12
3083	6-10-18	6-22-18	♂	12
3155	6- 5-18	6-20-18	♀	15

The minimum length of the pupal stage was found to be 8 days, and the maximum 20 days. An average of the figures in Table III gives 13.8 days as the average length of the pupal stage.

ADULT.—The adult of this species is an exception among the May-beetles in that it is a day flier, pupation occurs in the early summer rather than in the fall, the adults do not live over winter and the females are wingless. The adult beetles (Fig. 5) are brown in color and when freshly transformed are covered with small lanceolate cinereous scales which rub off when abraded, leaving a few scales to form discal vittæ on the elytra.

The beetles vary in size from 13 to 17 mm. The females are much larger than the males and are strongly ovate in form, while the male is more oblong with its sides nearly parallel. Since the genitalia of *Lachnosterna* are strong taxonomic characters, those of *L. lanceolata* are shown in Figure 6.

In the vicinity of Mahattan, Kansas, adults are abundant in pasture land from the early part of June to the last of July. The females are to be found crawling on the ground or up the stems of pasture plants. The males are strong fliers and fly from plant to plant. Mating occurs on the surface of the soil or on plants. The proportion of sexes of over nine thousand individuals collected in two summers was found to favor the females one year and the males the next. The beetles fly and crawl from early morning till the hotter parts of the day, at which time they burrow into the ground to avoid the heat.

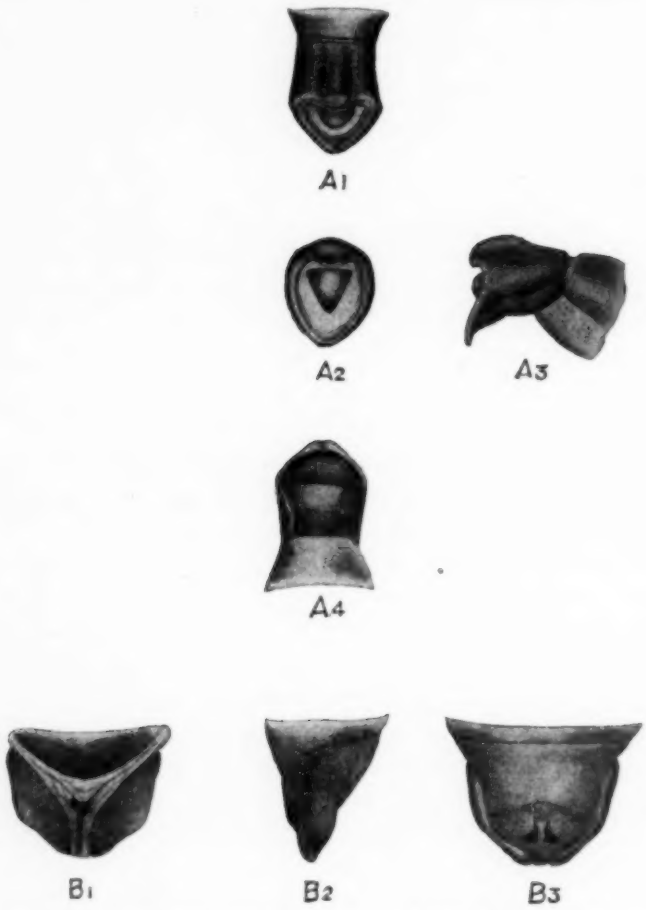


Fig. 6. Genitalia of *Lachnosterna lanceolate:* *A*—Male; *B*—Female; A_1—Dorsal aspect; A_2—Caudal aspect; A_3—Lateral aspect; A_4—Ventral aspect; B_1—Ventral aspect; B_2 Lateral aspect; B_3—Dorsal aspect.

Length of Life-Cycle

To summarize the life-cycle of a single generation of *L. lanceolata*, we find the beetles appearing and laying eggs during June and July. The eggs hatch in July and August. The average length of the egg stage was found to be 16 days. Larvæ are present until June of the second year, giving a larval stage of slightly over 22 months. Pupæ occur in June and July with an average stage of 13 days. Two full years are thus required for development, and, in some cases, where the larval stage is prolonged, three years may be required. However, two

years seems to be the normal length of the life-cycle in Kansas. The generations overlap each other so that all stages appear every season. This is evident from the large number of adults present each year. Table IV shows the number of beetles collected at Manhattan, Kansas, during the past three seasons.

TABLE IV—RECORD OF COLLECTIONS OF ADULTS

Year	1916			1917			1918		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
Number	557	1506	2063	1529	2004	3533	3322	2382	5704

FOOD PLANTS

The adult beetles are quite general feeders and have been observed eating a variety of different plants. From the literature, cotton, corn, wild sunflowers, collards, and careless weed (Amaranthus) are reported as food plants. Table V lists a number of plants on which the adults were observed feeding.

TABLE V—FOOD PLANTS OF *Lachnosterna lanceolata*

Observed Feeding in the Fields	Observed Feeding in Cages
Pigweed—*Amaranthus* sp.	Pigweed—*Amaranthus* sp.
Crab grass—*Panicum sanguinale*	Sunflower—*Helianthus* sp.
Evening Primrose—*Oenothera biennis**	Corn—*Zea mays*
Pepper grass—*Lepidium* sp.	Evening Primrose—*Oenothera biennis**
Corn—*Zea mays*	Elm—*Ulmus americana*
Bindweed—*Convolvulus* sp.	Cherry—*Prunus* sp.
Bladder Ketmia—*Hibiscus trionum*	Sumach—*Rhus* sp.
Ironweed—*Vernonia baldwinii**	Willow—*Salix* sp.
Shoestring plant—*Amorpha canescens**	Oats—*Avena sativa*
Sumach—*Rhus* sp.	Brome-grass—*Bromus inermis*
Clover—*Trifolium* spp.	Foxtail—*Setaria* sp.
Little Ragweed—*Ambrosia psilostochyla**	Smartweed—*Polygonum* sp.
Vervain—*Verbena stricta**	Apple—*Pyrus malus*
Hoary Aster—*Aster sericeus**	Kafir—*Andropogon sorghum*
False boneset—*Kuhnia eupatorioides**	Crab grass—*Panicum sanguinale*
Sampsoni snakeroot—*Psoralea pedunculata**	Pepper grass—*Lepidium* sp.
Golden rod—*Solidago rigida**	Milo—*Andropogon sorghum*
Oats—*Avena sativa*	Peach—*Prunus persica*
Liatris (spicta?)	Curled dock—*Rumex crispus*
Venus' looking glass—*Specularia perfoliata**	Beet—*Beta vulgaris*
Thistle—*Cirsium* sp.	Bean—*Phaseolus vulgaris*
Yarrow or Milfoil—*Achillea millefolium**	Potato—*Solanum tuberosum*
Little Blue Stem Grass—*Andropogon scoparius*	Cabbage—*Brassica oleracea*
Sunflower—*Helianthus* sp.	Tomato—*Lycopersicum esculentum*
Alfalfa—*Medicago sativa*	Peas—*Pisum sativum*
Cocklebur—*Xanthium* sp.*	Bladder ketmia—*Hibiscus trionum*
Big Blue Stem Grass—*Andropogon furcatus*	

It is interesting to note that the adults were frequently found feeding abundantly on wild clover while an adjacent alfalfa field was always

* Det. H. F. Roberts

free of the beetles. However, in Dickinson County, Kansas, one specimen was found feeding on alfalfa. In pasture land, ironweed (*Vernonia baldwinii*), Evening primrose (*Oenothera biennis*), and white clover (*Trifolium repens*) are apparently important food plants. The beetles are to be found abundantly near those plants. There is some evidence that the females prefer to lay their eggs at the base of the ironweed plants. In one case 81 eggs were found within a radius of two inches from an ironweed plant and in the first eight inches of soil.

Natural Enemies

Natural enemies are not abundant in Kansas. None of the common parasites of *Lachnosterna* have yet been noted. However, one adult of a Sarcophagid fly, *Sarcophaga prohibita* Ald., was reared by J. J. Davis from material sent him by the writer. This is his first record of this species from *Lachnosterna* and he believes it a true parasite as the species is one of the group of true parasitic Sarcophagids.

Control Measures

The methods of control for this and other white grubs have not been clearly worked out as yet, owing to the fact that the grubs live entirely below the surface of the ground, and that they require two or three years to complete their development. One of the striking features in the injury to wheat by *lanceolata* is that the damage is occurring in those fields that have been in wheat for a period of years. The injury seems to be cumulative, increasing in severity from year to year. This is due to the fact that the females are wingless and do not leave the field, but deposit their eggs in the same area from which they emerged.

One of the best means of control thus far known is that of rotation of crops. The planting of corn or sorghums on infested land has often served to eliminate the field of grubs in one year. Another factor in the use of corn and sorghum is that repeated working of the ground destroys the grubs in large numbers. A rotation of corn, oats and wheat has proved very effective in prevention of damage by this species. A striking example of the effectiveness of such a rotation was observed by Mr. J. W. McColloch in Harper County, Kansas, in the fall of 1918. An 80-acre field that had been in wheat continuously until 1917 was divided into a north and south half. The north half was allowed to remain in wheat. The south half was planted to corn in 1917, to oats in the spring of 1918, and wheat the same fall. At the time of writing (November, 1918) the north half of the field is a total loss while in the south half there is scarcely a plant missing. On the west of this particular field there is another field that has been in wheat for three years. A few grubs are present, but not enough to injure the crop.

In the practice of rotation for the control of this species it is evident that a change in the cropping system is hardly necessary more often than once in five years.

Where the area infested is small, it has been found practical to allow hogs to run on the field temporarily. Hogs show a great preference for white grubs, and will root to a depth of several inches to get them.

Plowing immediately after harvest, and keeping the ground free from all vegetation during the summer is always practical, since this procedure will deprive most of the grubs and the adult beetles of food. The keeping down of weeds around the edge of the field will also deprive the adults of food.

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RECENT RESULTS IN THE FUMIGATION OF CITRUS TREES WITH LIQUID HYDROCYANIC ACID

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The fumigation of citrus trees with hydrocyanic acid gas has been performed in California for more than thirty years and during this period more radical changes in apparatus and methods have occurred than is to be found in the annals of any other insecticide either in this state or elsewhere. The original so-called "dry gas" process in which undiluted sulphuric acid was poured slowly into a cyanid solution, the resultant gas passing through a sulphuric acid bath, gave way in 1890

to the "pot method," which consists of placing dry cyanid with diluted sulphuric acid in an open vessel beneath the tented tree. In 1912 a simplified portable machine for generating cyanid gas outside the tent was invented and this method of application rapidly and successfully displaced the "pot method." The latest development, liquid hydrocyanic acid, has proved the most revolutionary of all changes in field fumigation, promising ultimately to completely supersede current practices.

In 1915 C. W. Mally,[1] working in South Africa, prepared and experimented with liquid hydrocyanic acid. It happened that William Dingle, of Los Angeles, one of the inventors of the machine method of generation, began to develop simultaneously but entirely independently the same method and, in the early spring of 1916, publicly demonstrated the fumigation of citrus trees with liquid hydrocyanic acid.

Liquid hydrocyanid acid is by no means new, having been known to chemists for many years. In its pure state it is a colorless liquid with a specific gravity of .70 at 65° F. The high volatility of this substance (it boils at 80° F.) produces easy gasification at the ordinary temperatures of fumigation. If impure it decomposes rapidly.

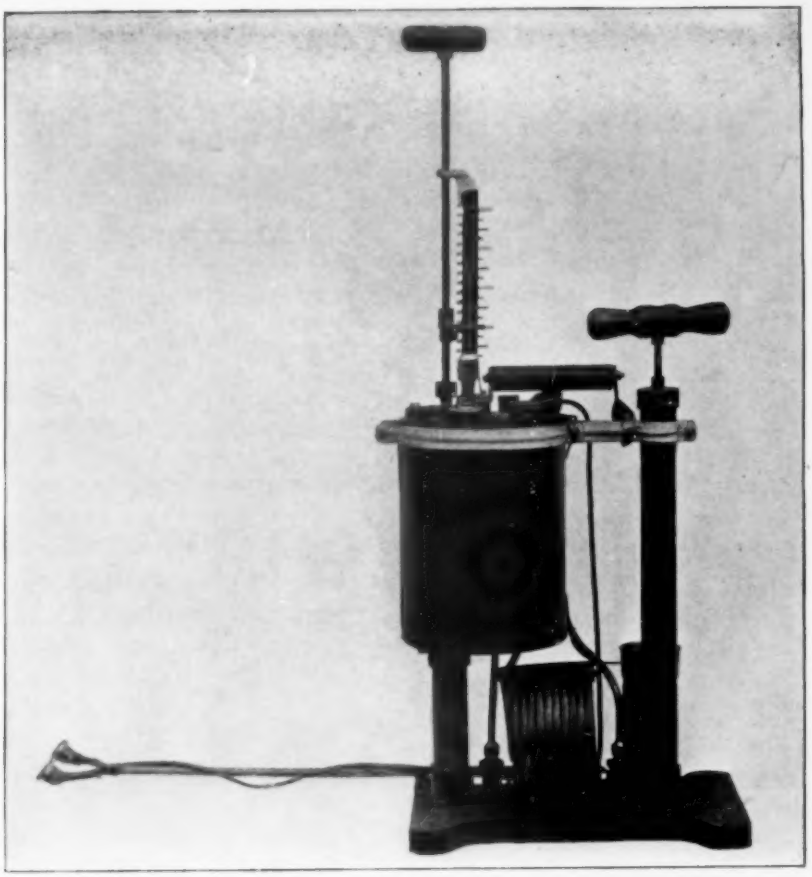
The application of this gas to the tented tree is extremely simple. A tank, suitably vented, holding about two gallons, is mounted on a platform with a measuring device and a pump (Pl. 4, Fig. 1). The liquid hydrocyanic acid, after measurement into storage coils, is forcibly discharged through a short rod fitted with a mist type of spray nozzle, and quickly disappears as an invisible gas.

During the season of 1917 approximately 540,000 pounds of solid sodium cyanid were converted into liquid hydrocyanic acid for the use of thirty fumigation outfits.[2] So far this year more than one million pounds of sodium cyanid have been similarly treated for the use of ninety-four fumigation crews.[2] A very much greater amount would have been used could it have been produced.

Gas Distribution

It has been the writer's belief for many years that gas distribution is influenced by the method of application or generation and in 1908 this led to the invention of a cover device[3] for deflecting the rise of gas from a generating vessel. In pot fumigation a dense column of gas rises rapidly from the generator until deflected by the branches, foliage and ultimately the tent. The spreading of the gas through the lower part of the tree follows the forcing downward of the diffused column after

[1] South Africa Jl. Sci., v. 12, No. 3.
[2] Data obtained from the concern that liquifies hydrocyanic acid.
[3] U. S. Dept. Agr. Bur. Ent. Bull. No. 79, p. 58.



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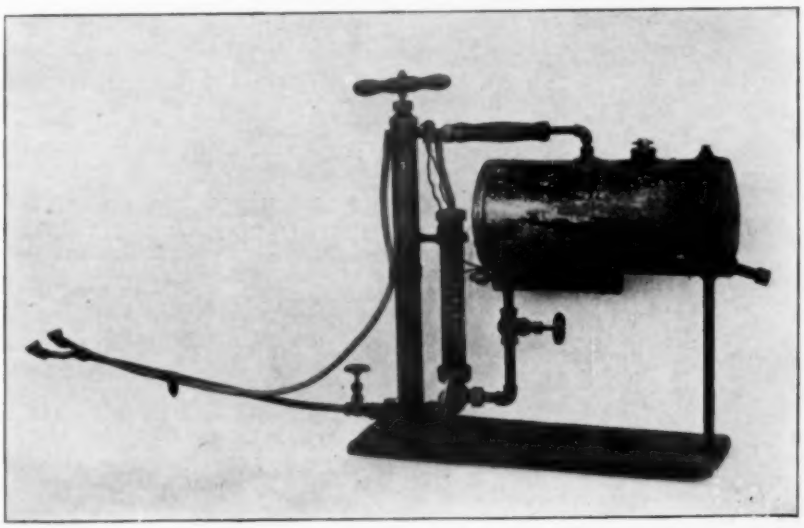

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Machines for Applying Liquid Hyrdocyanic Acid in Field Fumigation; 1, Plunger type used almost exclusively during 1918; 2, Gravity type used during 1917 and to a limited extent during 1918.

contact with the tent top. This initial condition would point to the top of the tent receiving maximum gas distribution sooner than the bottom. Furthermore, the effect of the rise of gas would tend to cause a greater concentration toward the top, although in a non-gas-tight enclosure such as a tented tree, various factors, as yet little understood, are constantly exerting important influences, changes in which must alter the movement of the gas particles to no little extent. The diffusion through the tenting is most important and unquestionably is modified by such factors as texture, its condition as to moisture, chemical treatment and accumulation of dirt particles. Furthermore, atmospheric conditions during the exposure have been proven to influence scale-kill, thus probably affecting tent leakage. Factors acting wholly within the tent, yet believed to affect gas concentration to some extent are absorption and adsorption of the foliage and the physical condition of the soil.

The violence of the reaction in an open generating vessel affects the denseness and velocity of the rising column of hydrocyanic acid gas. When the reaction is rapid the initial maximum gas concentration must needs follow more quickly than when the generation takes place over a protracted period. Furthermore, consideration of the fact that leakage occurs immediately on contact of the gas with the tent surface, injects a factor that might alter the maximum gas density attained between a slow or rapid generation. Such a view would signify a difference, possibly very slight, in pot-generated gas from potassium and sodium cyanid respectively, for solid potassium cyanid produces a violent reaction practically complete within one to three minutes. Solid sodium cyanid, on the other hand, is much slower in generation and low grade material used in California to a limited extent several years ago was observed in some cases to require fully fifteen minutes for complete liberation of gas.

The gas evolved from fumigating machines is in the form of a dense cloud injected with much force at one edge of the tent along the ground. The evolution of the gas is almost instantaneous and in a different initial direction to that of pot generation. Thus the condition surrounding the concentration and distribution of this gas, in differing from that generated in vessels within the tented tree, gives grounds for possible difference in results between the two methods.

After this brief discussion of gas-distribution in pot and machine practice, let us consider liquid hydrocyanic acid. This latter is injected at the edge of the tent with a small amount of force, as a mist, which on evaporating is left with little initial momentum. The result is a gas somewhat distributed toward the bottom of the tent, having much less initial velocity than in the case of gas generated under former

methods. Furthermore, the gas from liquid hydrocyanic acid is cooled almost to the freezing point on formation and consequently is decidedly heavier than the hot machine or pot-generated product (temperature of pot-generated gas is 100° to 153° in accordance with dosage).[1]

Since the molecular activitiy of gases increases proportionately as the temperature, it is evident that we have a very differently acting product in the new than in the old practice. The molecular activity of gas from liquid hydrocyanic acid is least when first generated but increases as it attains the temperature of the air, while in pot or machine generated gas quite the inverse is true, the initial molecular velocity of these being the greatest and decreasing as the gas cools to the lower air temperature. Thus it is evident that initial diffusion would be slower in the case of liquid hydrocyanic acid, and attained throughout the bottom of the tent sooner than the top. Differences in diffusion and molecular activity would signify a difference in tent leakage between the generated and atomized gas and that such takes place under field condition is readily detectable by careful observation.

The destruction of scale pests on citrus trees is proportional to gas concentration and hydrocyanic acid gas being lighter than air, it is natural to presume that the greatest density, signifying the best scale-kill, is toward the top of the tent. This presumption has been supported by the observation of practical fumigators and the experiments of investigators, of whom one of the first to give definite proof in support of this condition was Morrill[2] in 1908, working in Florida with the citrus white fly, *Dialeurodes citri*. More recently Quayle[3] conducted tests under tent forms with the Bean Weevil (*Acanthoscelides obtectus*) and the Granary Weevil (*Calandra granaria*) arriving at the same general conclusion, that the highest mortality is toward the top of the tent. Quayle, however, concluded that the percentage killed in the case of a tall tree is better toward the center than the top, a conclusion not in keeping with the data presented.

The writer has been conducting an investigation of the use of liquid hydrocyanic acid with special reference to dosage requirements and during the past season has closely followed the fumigation of more than 500 acres of citrus trees. It was felt that the difference in physical properties between gas obtained from liquid and field-generated hydrocyanic acid is sufficient to demand a careful revision of the dosage schedule originally prepared for pot-generated gas, but subsequently also adopted for machine and liquid hydrocyanic acid fumigation.

Accordingly gas diffusion was one of the first problems taken up,

[1] U. S. Dept. Agr. Bur. Ent. Bull. 79, p. 37.
[2] U. S. Dept. Agr. Bur. Ent. Bull. 76, p. 51.
[3] Jr. Econ. Ent. 11, 3, 1918.

the determination of which was undertaken entomologically by obtaining data on scale-kill in different parts of tented trees. The results are in part herewith presented:

TABLE I

Table showing the mortality of purple scale (*Lepidosaphes beckii*) at different heights above the ground on trees fumigated with liquid hydrocyanic acid. The females were largely in the egg stage and each adult with its egg quota was considered a unit:

Tree No.	Height Above Ground					
	1–2 Feet		3–4 Feet		8–11 Feet	
	Total Insects Examined	Per Cent Living	Total Insects Examined	Per Cent Living	Total Insects Examined	Per Cent Living
1	434	3.4	280	2.63	300	8.1
2	...	..	400	6.84	300	8.77
3	300	2.8	...	....	451	5.14
4	300	3.16	...	....	300	4.91
5	145	5.84	276	2.67	439	10.79
6	173	3.00	600	1.93	599	9.47
7	100	3.2	300	1.4	300	15.1
Total per cent living		3.41		3.12		8.85

Dosage—Approximately schedule ¾ for sodium cyanid.
Exposure—85 minutes.
Temperature—70°.
Inspectors—R. S. Woglum, M. B. Rounds.

The results of this experiment show that in each of the seven trees, the scale-kill was more effective toward the bottom of the tree than toward the top. Out of a total of 1452 insects at 1 to 2 feet for all the trees, 3.4 per cent were living while at 8 to 11 feet, 8.85 per cent of the 2689 examined were alive. Thus the percentage of living insects toward the top of the trees in these tests is noticeably greater than towards the bottom, which would indicate that the difference in gas density is proportionally pronounced.

TABLE II

Table showing the mortality of red scale (*Chrysomphalus aurantii*) at different heights from the ground on small trees fumigated with liquid hydrocyanic acid. Totals of six trees:

Height Above Ground	Total Insects Examined	Per Cent Living
1 ft.	1622	1.46
2 "	897	3.06
3 "	2162	10.29
4 "	1346	12.07
5 "	727	11.17
6 "	219	11.99

Dosage—Approximately schedule I for sodium cyanid.
Exposure—1 hour.
Temperature—66°.
Inspectors—R. S. Woglum, M. B. Rounds.

The results of these two experiments demonstrate that the scale-kill with liquid hydrocyanic acid as at present used is decidedly better toward the lower part of the tent than toward the top. This result was plainly shown in each of the trees which comprised these tests as well as in the totals. Scale-infested units within a few inches of the ground showed a higher mortality than units in the tops of tall trees.

TABLE III

A comparison of these results as summarized in Table I with those obtained by Morrill[1] and Quayle[2] for gas generated in pots is both interesting and instructive:

Part of Tent	Percentage of Insects Killed at Different Heights Above Ground		
	Liquid HCN (*a*)	Pot Generated Gas	
		Morrill (*b*)	Quayle (*c*)
Top	91.15%	71%	65.6%
Bottom	96.59	64	38.8

(*a*) Average percentage of 7 trees with purple scale.
(*b*) Average percentage of 6 experiments with citrus white fly on large trees.
(*c*) Results of 121 experiments with the bean and granary weevils under tent form about 12 feet tall.

The conclusion reached by both Morrill and Quayle for pot-generated gas is that the killing effect is decidedly better toward the top of the tree than the bottom.

A striking difference between these results and those with liquid hydrocyanic acid is shown, the mortality with the latter being decidedly the greatest toward the bottom of the tent. In fact, the percentage of mortality for liquid hydrocyanic acid in favor of the bottom of the tent is almost inversely proportionate to Morrill's results with pot fumigation for the top. It should be noted that the experiments with liquid

[1] U. S. Dept. Agr. Bur. Ent. Bull. 76, p 51.
[2] Jr. Econ. Ent. 11, 3, 1918.

hydrocyanic acid were carried on at comparatively high temperatures. Fumigation at very low temperatures would tend to develop even greater differences in scale-kill at various distances from the ground.

This greater density of gas toward the bottom of the tent with corresponding increased efficiency will necessitate changes in the present dosage schedule based on pot generation. A dosage schedule for liquid hydrocyanic acid is now being prepared and will be ready for the coming season's work.

The question naturally arises, in view of the difference in distribution between gas from liquid hydrocyanic acid and the other methods of generation, as to any advantage or disadvantage therefrom in the use of this recent introduction. The infestation of scale insects on large citrus fruit trees is usually most severe on the lower or most protected part of the tree; especially is this true of the purple scale. The greater killing effect of liquid hydrocyanic acid at that part of the tree most severely infested with scale is the ideal to be sought, and at once brings this gas into favor over the field-generated product for citrus tree fumigation.

There are other advantages favoring liquid hydrocyanic acid, which in themselves indicate that this new method will displace all others. The expenses of an outfit are reduced by doing away with cumbersome apparatus such as pots, generating machines, sulphuric acid drums and boxes of cyanid. The cost of tent mending is almost entirely done away with as liquid hydrocyanic acid is harmless to cloth. The treatment of small trees, frequently with such poor results in the past, can be performed with greater accuracy and corresponding certainty of results. Greater speed in tree treatment can be attained than previously and it appears possible that the quantity of hydrocyanic acid required for scale-kill can be slightly reduced over that formerly required.

However, improvement in manufacture so as to furnish a uniformly high grade product free of impurities that might start decomposition, improvements in containers through the use of a material free from chemical action with the gas, and improvement in the field application to guarantee accurate delivery and complete gasification of the required charge are necessary before this gas is placed on the high plane demanded for orchard fumigation in California. Assurance has been given that these faults will be corrected in the immediate future, in which case by the end of another year the hundred outfits using this gas are certain to be greatly augmented for time to come, or at least until some scientist discovers a method of scale control its superior.

(End of proceedings, to be continued.)

Scientific Notes

European Corn Borer (*Pyrausta nubilalis* Hubn.). This notorious insect has been found in the vicinity of Schenectady, N. Y., over an area of approximately 400 square miles with the probability that subsequent scouting will extend the infested territory somewhat. The most significant feature is the occurrence of the insect on the Mohawk River flats, ground annually flooded to a depth of ten feet or more with a consequent probability of the pest being swept down the river to New York City or beyond. The infestation is probably of two years' standing and is decidedly less severe than that in the vicinity of Boston, Mass.

We have obtained the best results searching for this insect by examining sweet-corn stalks, specially those which have been worked over by cattle and stripped of leaves, for a circular entrance less than one eighth of an inch in diameter and usually showing a little discoloration on the margins. In a sparse infestation there may be also a few holes through the husks and very seldom injury to the ear. The entrance holes lead into a gallery and there may be a somewhat restricted boring or a larger one which, if it extends to the node, expands irregularly and frequently has somewhat blackened walls. Most of the insect's work is within three feet of the ground and usually in stalks more than one fourth of an inch in diameter. The yellowish grey caterpillar is about three fourths of an inch long, brown headed, minutely brown spotted and with a somewhat peculiar transverse suranal plate which is angulate laterally.

E. P. Felt.

Gracillaria zachrysa Meyr., Corrective Note. In the December, 1918, issue of the Journal of Economic Entomology (page 482), reference is made to *Gracillaria zachrysa* as a pest of apple foliage in northwestern India, especially for the reason that *G. azaleæ*, which was considered an identical species, had recently been introduced into the United States.

Under date of November 23, Mr. T. Bainbrigge Fletcher states that he is in receipt of an additional communication from Mr. Meyrick to the effect that *G. azaleæ* Busck is not identical with *G. zachrysa* Meyr.

Entomologists will therefore be interested to know that the species *G. azaleæ* is not to be feared as an apple pest in the United States.

L. O. Howard.

The Toad as an Enemy of the Chinch Bug. In connection with the interesting paper in the October, 1918, number of the Journal on the "Insect Enemies of the Chinch Bugs," by W. P. Flint, it might be of interest to note that the common toad (*Bufo lentiginosus americanus*) is an efficient enemy of this insect in Kansas. Garman (Ky. Agr. Exp. Sta. Bull. 91, pp. 60–68) reports finding six bugs in the stomach of one toad out of twenty examined. During the summer of 1913 the writer examined the stomach contents of five toads taken in wheat and cornfields and found the bodies or body fragments of chinch bugs in all of them. A toad, caught in a wheat field May 6, contained the bodies of 162 bugs, while a toad found in a wheat field the evening of June 5 had just eaten 12 bugs. In the latter case, feeding had apparently just begun, as the stomach was practically empty. Three toads taken in cornfields during July contained many legs, wings, and other fragments of chinch bugs, but it was impossible to determine the number eaten.

James W. McColloch, *Associate Entomologist,*
Kansas Agricultural Experiment Station.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

FEBRUARY, 1919

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. Photoengravings may be obtained by authors at cost. The receipt of all papers will be acknowledged.—EDS.

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The Honor Roll, prepared by the Secretary of the Association, is another indication of the respect gladly rendered to the men who have heard the call and taken their places with the fighting forces of the nation. Some, unfortunately, will never return.

Without detracting in the slightest from the high credit due these men, we call attention also to the war activities of other members of the Association. Some have laid aside their professional duties to devote themselves in whole or in part to special work. A notable case is that of Prof. V. L. Kellogg, widely known because of the conspicuous services he rendered, first on the Belgian Relief Commission and later with the National Food Administration—both vitally important. The war greatly stimulated interest in insects and sanitation and amply vindicated the foresighted investigations along this line begun by Dr. L. O. Howard some twenty years ago. We should also mention, in this connection, Dr. C. Gordon Hewitt of Canada. Both have rendered most valuable service along these lines and have enjoyed hearty and fruitful support from numerous associates and followers, some rendering conspicuous aid in solving important problems in medical entomology and sanitation. Practically every American entomologist has found a greatly increased field of usefulness by applying his special knowledge to the better solution of sanitary problems, the growing of larger crops and a material increase in the vitally essential animal products. They were all necessary to win the war. We rejoice that all members of the Association have recognized the call of duty and have "carried on" in a beautiful spirit of fellowship and service.

HONOR ROLL

ALLEN, H. W.—Sanitary Corps, U. S. Army
BAILEY, J. W.—U. S. Navy
BARBER, GEORGE W.—Lieut. U. S. Army
BECKER, GEORGE G.—U. S. Army
BOWER, L. J.—U. S. Army
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HOOD, J. D.—Capt. U. S. Army
HOWARD, N. F.—Lieut. U. S. Army
JENNINGS,[3] A. H. —Lieut. Sanitary Corps, U. S. Army
JONES, CHARLES R.—Acting Major, Officers Training Corps, U. S. Army
JONES, EDWARD R.—U. S. Army
KING, J. L.—U. S. Navy
KING,[4] VERNON, —Lieut. Aviation Section, British Army
KNIGHT, H. H.—Lieut. U. S. Army
LARRIMER, W. H.—Lieut. U. S. Army
LATHROP, F. H.—Lieut. U. S. Army
MASON, A. C.—U. S. Army
MASON, S. L.—Lieut. Aviation Branch, U. S. Army
MCDONOUGH, F. L.—U. S. Army

[1] Died as a result of aeroplane accident, July 4, 1918.
[2] Killed in action in France.
[3] Killed in France.
[4] Died as result of accident.

Osborn, H. T.—Capt. U. S. Army
Parker, H. L.—Lieut. U. S. Army
Pemberton, C. E.—U. S. Army
Rosewall, O. W.—U. S. Army
Safro, V. I.—Lieut. Aviation Branch, U. S. Army
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Seamans, H. L.—U. S. Army
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Weigel, C. A.—Sanitary Corps, U. S. Army
White, W. H.—Lieut. U. S. Army
Whitemarsh, R. D.—Capt. U. S. Army
Wiltberger, P. B.—Sanitary Corps, U. S. Army
Wolcott, G. N.—U. S. Army
Woods, W. C.—U. S. Army

BOOK REVIEWS

Manual of Vegetable-Garden Insects, by CYRUS RICHARD CROSBY and MORTIMER D. LEONARD. The Macmillan Company, New York. Price, $2.50.

For the past decade the only American book devoted exclusively to insects attacking vegetable crops has been Dr. Chittenden's "Insects Injurious to Vegetables." Now we have another volume, with information brought forward to date, and many new illustrations. This is a volume of 391 pages, and 232 figures. Some of the illustrations are from photographs, but a large proportion are from drawings made expressly for this book. Most of them are good. The subject matter is arranged in the following order: Insects Injurious to Cabbage and Related Crops; Pea and Bean Insects; Beet and Spinach Insects; Insects Injurious to Cucumber, Squash and Melon; Potato Insects; Tomato Insects; Egg-plant Insects; Insects Injurious to Carrot, Celery, Parsnip and Related Crops; Asparagus Insects; Corn Insects; Sweet-Potato Insects; Onion Insects; Insects Injurious to Minor Vegetable Crops; Cutworms and Army-worms; Blister Beetles; Flea-beetles; Unclassified Pests; Insects and Insecticides. The last chapter contains about seven pages devoted to the structure of insects. Under the headings Cutworms, Blister-beetles, and Flea-beetles, each species is treated separately. A few references to literature follow the account of each insect. The volume is supplied with table of contents and index, and from the printer's standpoint is attractive. Though some entomologists might prefer to group potato, tomato and egg-plant insects under one heading, or place the chapter on the structure of insects and insecticides at the beginning rather than at the end of the book, the present arrangement does not in any way interfere with the usefulness of the volume which must be granted a place on the shelves of the working entomologist, the vegetable grower, and the teacher of horticulture. It goes without saying that it should be placed in every important public library as well. (*Advt.*)

W. E. B.

Practical Queen Rearing, by FRANK C. PELLETT, American Bee Journal, Hamilton, Ill.

This small volume contains 103 pages and 40 illustrations, most of them half tones, is printed on supercalendared paper, and is provided with table of contents but no index. The scarcity of certain kinds of foods and especially sugar with the high prices prevailing during the war has been an important inducement to keep bees. In connection with beekeeping there is such a demand for good queens that the average beekeeper cannot supply it. Consequently queen-rearing specialists have appeared, and the present volume is a guide for those who wish to make a nice little business by rearing queens. Mr. Pellett is a man of experience, having formerly occupied the position of State Apiarist of Iowa, and is author of "Productive Beekeeping," Mr. Pellett is also author of "Our Backdoor Neighbors," and is now associate editor of the *American Bee Journal*. He has had an extensive experience in things apicultural, and though it is characteristic of beekeepers that they do not agree on methods or equipment, it is evident that this little book will prove useful to all who contemplate the rearing of queen bees for the home apiary or for sale. (*Advt.*)

W. E. B.

Injurious Insects and Useful Birds: Successful Control of Farm Pests, by F. L. WASHBURN, pages I to XVIII, + 1 to 453, 414 text illustrations and four colored plates. J. B. Lippincott Company, Philadephia, 1918.

This, one of the Lippincott Farm Manuals, might properly be classed as a farm zoölogy largely and properly devoted to insects, since their importance is certainly commensurate with the space assigned. The author has endeavored to supply the needs of high schools where agriculture is taught and of agricultural colleges which demand a good, though not too technical text-book embracing a wide field. The work also appeals to farmers, orchardists, vegetable growers, owners of gardens and housekeepers and in this latter respect differs from a number of entomological volumes issued during the last few years and restricted to the enemies of special crops. It is concerned with fruit pests of all kinds, including the citrus fruits, the insects affecting field crops and pasturage, vegetable gardens, house plants, shade and forest trees, those troublesome to man and in the house, attacking stock or poultry and pests in mills and elevators. The author's extensive personal experience with the last makes the chapter of special value, particularly with cereals at their present high prices.

We have noticed in this volume a very large number of insects and other animals of the United States with special reference to their economic importance. The accounts, necessarily brief, are comprehensive and in many instances the meaning of the text is made clearer by excellent illustrations. The chapter on birds and that in relation to the four-footed pests of the farm are valuable and pertinent additions. The author has realized his aim and produced a volume which should be of great service to a very wide clientele. It is an excellent text for the use of schools and colleges, a most desirable addition for many libraries and a very convenient volume for the working library of the professional entomologist (*Advt.*). E. P. F.

Current Notes

Capt. Allan H. Jennings of the Bureau of Entomology died in December, 1918.

Dr. J. G. Needham of Cornell University, Ithaca, N. Y., visited Washington and the Bureau of Entomology in October.

Lieut. E. H. Gibson, formerly of the Bureau of Entomology, has been promoted to the rank of captain in the Sanitary Corps.

Mr. C. H. Hadley, Jr., has been promoted from instructor to assistant professor of economic entomology at the Pennsylvania State College and Station.

Mr. J. W. Gilmore, Bureau of Entomology, has been granted an indefinite furlough to enter an officers' training camp. He was connected with the Southern field-crop insect investigations.

Prof. John P. Campbell, for thirty years professor of biology in the University of Georgia, died December 3, 1918. Several years ago, Professor Campbell published a number of papers on injurious insects.

The nursery stock, plant and seed quarantine, which has been discussed during the summer and fall, received the approval of the secretary of agriculture November 18, 1918, and becomes effective June 1, 1919.

According to the *Review of Applied Entomology*, Mr. F. H. Taylor of the Australian Institute of Tropical Medicine has been appointed entomologist to the Special Blow-Fly Committee of the Federal Bureau of Science and Industry at Queensland.

Mr. K. L. Cockerham of the Bureau of Entomology, who is experimenting with heat control of the sweet potato weevil in Mississippi, reports promising results from some of his recent experiments against the weevil in stored tubers.

Dr. J. C. Hutson, formerly of the Imperial Department of Agriculture, Barbadoes, British West Indies, has been appointed government entomologist of Ceylon with headquarters at the Royal Botanic Gardens, Peradeniya, Ceylon, and will soon enter upon his duties.

Mr. E. W. Scott in charge of the Vienna, Va., laboratory of the Federal Insecticide Board was granted an indefinite furlough to enter the Quartermaster's Corps of the army where he was granted a commission as first lieutenant.

Mr. George M. Anderson, formerly assistant to the state entomologist of South Carolina, has been appointed extension entomologist by the Bureau of Entomology and assigned to North Carolina, where he will carry on extension work in the whole field of economic entomology.

Mr. Irving W. Davis has been discharged from military service where he was a corporal in the U. S. Marine Corps, stationed at Paris Island, S. C. He has resumed his former work in charge of the gipsy moth field work in Connecticut, with headquarters at Danielson.

Mr. V. I. Safro has been discharged from military service, where he held a commission as second lieutenant in the Aviation Corps, and will resume his former position as entomologist for the Kentucky Tobacco Products Company, Louisville, Ky. On his return he visited a number of economic entomologists in the Eastern States.

Dr. J. M. Aldrich who has recently been attached to the West Lafayette, Ind., laboratory of the Bureau of Entomology has been transferred to Washington, D. C., to fill a vacancy on the miscellaneous roll of the Bureau caused by the death of Mr. Frederick Knab, as honorary custodian of the non-muscoid Diptera in the U. S. National Museum.

Dr. E. F. Phillips and Mr. George S. Demuth spent a large part of the months of November and December in California where they investigated the bee-keeping possibilities of the National Forest Reserves in Southern California. They then took part in the extension schools for commercial bee-keepers at San Diego, Davis, Visalia, and Riverside.

The Entomological Society of America did not hold its usual series of meetings for the reading and discussion of papers this year. Two brief sessions were held at Baltimore for the transaction of the necessary business. The following officers were elected for the coming year: President, James G. Needham; First Vice-President, James W. Folsom; Second Vice-President, R. V. Chamberlain; Secretary-Treasurer, J. M. Aldrich.

Mr. Allen B. Duckett, assistant entomologist in the Bureau of Entomology and connected with the Stored-Product Insect Investigations, died from pneumonia October 8, 1918. Mr. Duckett was a graduate of the Maryland Agricultural College, had been connected with the Bureau of Entomology for more than seven years, and at the time of his death was engaged in inspecting army stores at the port of New York.

No pink bollworm has been found in Texas this year and the Board is therefore joining with the Commissioner of Agriculture of Texas in a recommendation to the governor of that state that the growing of cotton be permitted under certain conditions within the quarantined districts. These restrictions will involve complete control of the seed for planting and of the disposition of the crop produced in the season of 1919.

George Compere, one of the efficient port inspectors of the State of California, at San Francisco, has been loaned to the Federal Horticultural Board to investigate conditions at New Orleans and possibly Mobile to determine whether or not port inspection should be inaugurated and maintained at these ports along the lines now conducted for the port of San Francisco. It is expected that Mr. Compere will spend the months of January and February in this investigation.

The following appointments in the Bureau of Entomology have been announced: Extension work in apiculture—J. V. Ormond, Arkansas, Kansas, Missouri, and Nebraska; Edward S. Provost, South Carolina; J. Smith, California. Extension work, deciduous fruit insects—George H. Miller, Albion, N. Y. Extension work, cereal and forage insects, Harvey H. Miniger, South Dakota; Karl M. Pack. Extension work in general economic entomology—George M. Anderson, North Carolina; M. B. Rounds, citrus fruits, California; E. E. Wehr. Extension work with insects affecting domestic animals—J. Touhy, assistant in body-louse investigations; Harrison E. Smith, work with European corn borer, Boston, Mass.

Resignations in the Bureau of Entomology have been announced as follows: To enter military service—Charles W. Curtin, Carolina; H. M. Fort, Missouri; Marshall Hertig, Minnesota; G. J. Hucker, Nebraska; J. M. Lowe, Texas; Max W. Reeher, Oregon; Douglas R. Royter, Texas; A. I. Fabis, Texas; H. L. Seamans, Montana; Paul Starkweather, Georgia. Twelve inspectors, Federal Horticultural Board—W. W. Decell, J. A. Dew, E. L. Diven, W. S. Hough, Herbert Lahr, M. I. Miller, E. J. O'Dowd, R. W. Reeves, Torbert Stack, J. E. Webb, C. A. Weigel, J. C. Woodward, A. Burr Black, Albert E. Booth, Mancil B. Boyd, Kenneth E. Bragdon, F. Vernon Griffith, J. G. Griffith, Montfort Hull, H. E. Jaques, H. B. Pierson, E. L. Prizer, Frazier Rogers, C. E. Trimble, G. H. Vansell, H. L. Weatherby, M. J. Kerr, Miss Mabel Connell; H. J. Ryan, California, to become horticultural commissioner of Los Angeles County, Cal.; Wm. R. Martin, Earl Ranells, J. M. Robinson, J. Howard Smith, Henry E. Bailey; Clyde C. Hamilton, to enter the State Service of Missouri; J. E. Morrison, to become a county agent in Colorado.

The following transfers have been made in the Bureau of Entomology: Oscar Barber, sweet potato weevil, Texas, to another branch; M. E. Kimsey, cereal and forage insects, Arizona, to pink bollworm work, Texas; Q. S. Lowry from extension work with truck crop insects to general economic insect extension work in Massachusetts; S. E. McClendon, headquarters, Hawkinsville, to Athens, Ga.; M. R. Smith, Plymouth, Ind., for the winter to Kingsville, Texas; M. H. Arnold, Mississippi, for the winter to Texas; F. M. Wadley, Wichita, Kans., to Muscatine, Iowa; O. K. Courtney, Maryland, truck crop insects to Federal Horticultural Board; C. E. Smith, New Orleans, La., to Texas; B. R. Leach, Bennett A. Porter, R. J. Fiske, and R. B. McKeown, deciduous fruit insects, temporarily to Federal Horticultural Board for work on pink boll worm in Texas; F. H. Gates, corn borer work to alfalfa insect investigations, Tempe, Ariz.; A. F. Satterthwait, Charleston, Mo., to Webster Groves, Mo.; L. C. Griffith, extension work, New York, to Federal Horticultural Board; Frank J. Rimoldi, extension work, Rhode Island, to Federal Horticultural Board, Texas; A. C.

Burrill, Washington, extension work to cereal and forage insect investigations; C. H. Batchelder, extension work, Maine, to truck crop insect investigations; W. T. Ham, extension work, Washington, to truck insect investigations; R. A. Epperson, Alabama, temporarily to work on the pink bollworm in Texas.

Mr. Warren Williamson has resigned as instructor in entomology and assistant entomologist at the Minnesota University and Station.

According to *Science* Dr. J. F. Abbott, professor of zoölogy at Washington University, has been appointed commercial attaché to the American Embassy at Tokyo and will leave for Japan in February.

According to the *Experiment Station Record*, the Misses Emily H. Payne, Ida R. Saul and Anna Wentz have been appointed assistants in entomology at the Minnesota University and Station to replace men who were called to military service.

According to *Science* at the annual meeting of the Brooklyn Entomological Society held on January 16, the following officers were elected for 1919: President, Mr. W. T. Bather; Vice-President, Mr. W. T. Davis; Treasurer, Mr. C. E. Olsen; Recording Secretary, Dr. J. Bequaert; Corresponding Secretary, Mr. J. R. de la Torre Bueno; Librarian, Mr. A. C. Weeks; Curator, Mr. George Frank; Publication Committee, Messrs. J. R. de la Torre Bueno, Charles Schaeffer and George Engelhardt.

According to *Science* Dr. James A. Nelson has resigned his position as expert in the Bureau of Entomology, though he will still be connected with the Bureau as collaborator, and will make his home near Mount Vernon, Ohio, where he will give his attention to farming.

Mr. R. L. Webster, formerly of the entomological department of the Iowa College and Station, is now at the entomological department of Cornell University, Ithaca, N. Y., where he holds an industrial fellowship, and is working on the practicability of fumigation of deciduous fruit trees with hydrocyanic acid gas.

Mr. Frank D. Heckathorn, deputy inspector, Bureau of Horticulture, Department of Agriculture of Ohio, died December 18 after a short illness with influenza. He was graduated from the Ohio State University in 1906. Mr. Heckathorn was a careful, conscientious worker who gained the respect of everyone with whom he came in contact.

European corn borer conferences have been numerous since the discovery of this pest in New York State. The first was held at Albany, February 7, and was attended by three representatives of the Federal Bureau of Entomology, and a number of New York entomologists. A second occurred at Washington, February 12th, at which time Messrs. O'Kane, Sanders, Reynolds, of the American Plant Pest Committee, and Felt conferred with the Senate Committee on Agriculture and Doctor Howard of the Bureau of Entomology. There was a third the next day at Ithaca, attended by New York entomologists and agriculturists followed by a fourth at Albany, February 18th. The outcome of recent activities and interest has been the adoption by the State of New York of an aggressive policy toward this new menace and a material increase in the amount recommended by the Secretary of Agriculture for use in control or extermination work.

Mailed February 28, 1919